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ELECTRICITY AT THE MINING EXPOSITION, SANTIAGO, CHILI.

BY

Harry Bindemann

THOUGH a small local exhibition in a rather far-off corner of the world, the Mining Exposition of Santiago, Chili, recently closed has been a success, opening avenues for European and American commerce, and directing the attention of the Chilian mining public to the splendid advantages of modern mining machinery, of electric transmission of power, electric lighting and electro-metallurgy. The electric manufacturing concerns in Europe and the States have certainly much to be thankful for regarding this exposition, because the Chilian public has been able to see that electricity has passed from the stage of experiment some years ago to healthy and systematic development.

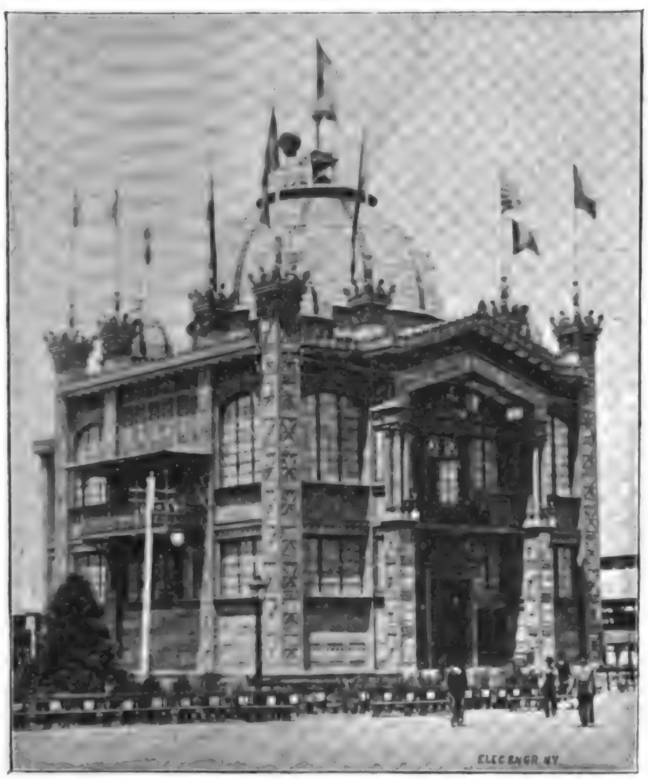


FIG. 1.—SCHUCKERT SEARCH LIGHT AT THE SANTIAGO, CHILI, MINING EXPOSITION.

Foremost among the electrical exhibits was that of the well-known firm of Schuckert & Co., of Nuremberg, Germany, now the Schuckert Electrical Company, Limited, of search-light fame at the World's Columbian Exposition of 1893. The Company were represented at the exhibit by their agents for Chili, Messrs. Saavedra, Bénard & Co., who spared neither pains nor money to develop an exposition worthy of the high reputation they are fast gaining. The exhibition of these gentlemen, who preferred to have it under their own roof instead of together with, and amongst a lot of, ill-assorted competitive machinery, was in itself a collective one, Schuckert dynamos being driven by the famous "Otto"-Deutz gas, petroleum or benzine engines, Rudolf Wolff's portable steam-engines, lubricated with oil from the Standard Oil Co., of New York, and the belting supplied by C. Otto Gehrckens, of Hamburg.

The plan of this special pavilion, Fig. 4, and the engraving of the interior Fig. 2, will show the general arrangement of the machinery and exhibition objects. Prominent among the generating machinery, as regards economy and regularity of working, besides perfect workmanship, was one of Wolff's portable 24 H. P. steam-engines, driving a Schuckert 4-pole, 19 KW. shunt-wound dynamo. There was also a 6 KW. bi-polar, ironclad, shunt-wound dynamo driven by an 8 H. P. double-cylinder "Deutz" gas engine. Besides these there was a storage battery in a separate room, consisting of 60 "Tudor" cells from the celebrated Hagen (Westphalia) firm, with a normal capacity of 250 ampere hours. The switch-board connections of these three current-generators are clearly shown in Fig. 3. The circuits for the electric motors, the descriptions of which are given later on, were all connected to one half the positive, the lighting circuits for the building and two search-lights, to the other half of the bus-bar. Now, by means of two three-throw switches I and II *b*, *c*, any one dynamo or the battery could be connected to the power or light bars, as shown in the diagram; or by closing switch III, the whole system could be worked in parallel. This division between light and power was obviously necessary in case of the small

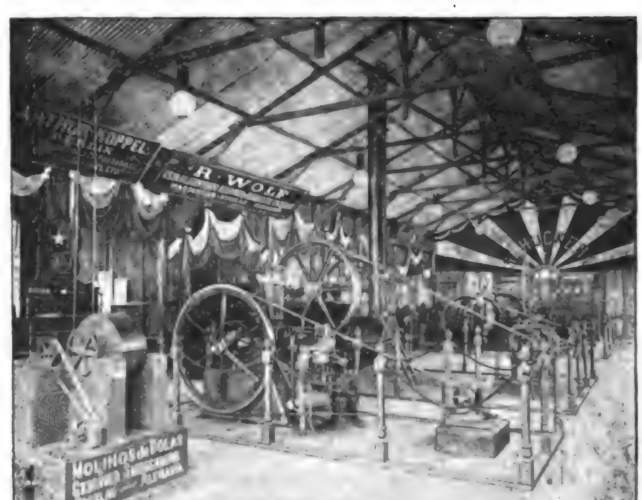


FIG. 2.—INTERIOR VIEW SCHUCKERT PAVILION.

mining railway being in use, the starting of which would naturally have produced a flicker in the lights. With the battery in parallel to a dynamo, however, this was found

to be reduced to a minimum. The contacts *a* I, *a* II, were used for charging the battery, the necessary switching on and off of the cells being done by means of a double cell switch, the idea of which is clearly depicted in the diagram.

This cell switch in general has been made a special study by the Schuckert firm, and has found very extensive use in its various developments in many of the largest central-stations in Europe. The discharging switch in this case was worked automatically, the contact-shifting handle being turned by a small electromotor, the back or forward motion of which was controlled by a delicately adjusted solenoid, shunted across the mains. In this manner the pressure of 110 volts between the lighting bus bars was kept absolutely steady. The remaining apparatus and connections are so simple as to need no detailed description.

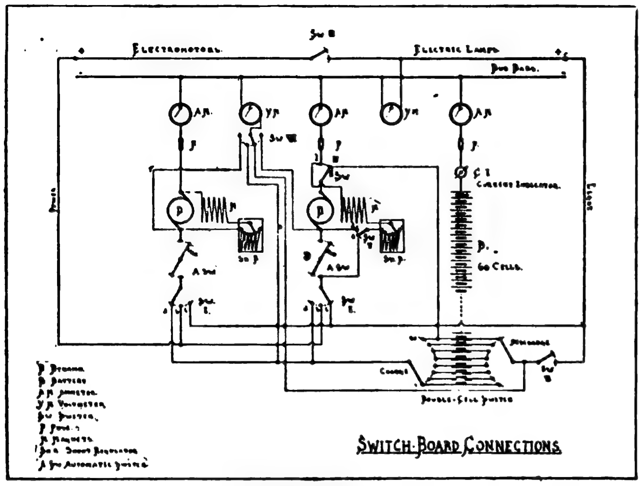


Fig. 3.—Switchboard Connections of Generators, Batteries and Motors.

There still remains for notice, however, an interesting use of the storage battery for starting the gas engine by the dynamo running for a short time as an electric motor. This is accomplished by sliding the cell-charging switch down to cell No. 20, putting switch V on contact *e*, switch II on contact *a*, closing the shunt regulator, thereby exciting the magnets of the dynamo; then throwing switch IV on contact *g*, closing the automatic switch, and slowly sliding the charging switch up again, in this manner sending the current of 20 cells through the armature and starting the gas engine. As soon as the gas engine "ignites," the automatic switch opens at the same moment, the armature current suddenly falling. By this means all starting resistance is completely done away with. Switch IV in every other case always remains closed on *f* and switch V on contact *d*. There will be also noticed on the plan Fig. 4 two smaller oil engines and a benzine engine built by the Deutz firm and driving Schuckert dynamos, which were used to furnish lighting current to other adjoining buildings, as for instance the banquet-hall, the restaurant, etc. The current generated by the larger machines before mentioned, was exclusively used for driving the different electric motors, the electric mining locomotive, two search-lights, one of 50, the other of 75 amperes; an electro-metallurgical establishment, besides the general lighting of the building.

There were further exhibited a centrifugal pump coupled on the same shaft to an electric motor, and capable of lifting 40 gallons of water per minute to a height of about 150 feet; also a mining hoist with one cable-drum, connected by spur-gearing to a 7 H. P. electric motor with reversible motion. Besides these there was a high-pressure mining ventilator capable of furnishing about 2,300 cubic feet of air per minute.

The mining railway was constructed on the overhead system, imitating the conditions existing inside a mine; the small locomotive was furnished with a 8 H. P. electric motor, driving the wheels directly by means of worm-gearing running in oil. The current entered from the overhead wire by means of a ┌┐ shaped copper sliding bar, past the starting resistance, which could be controlled from outside by a simple lever movement, and, passing the motor, returned by the copper-bonded rails.

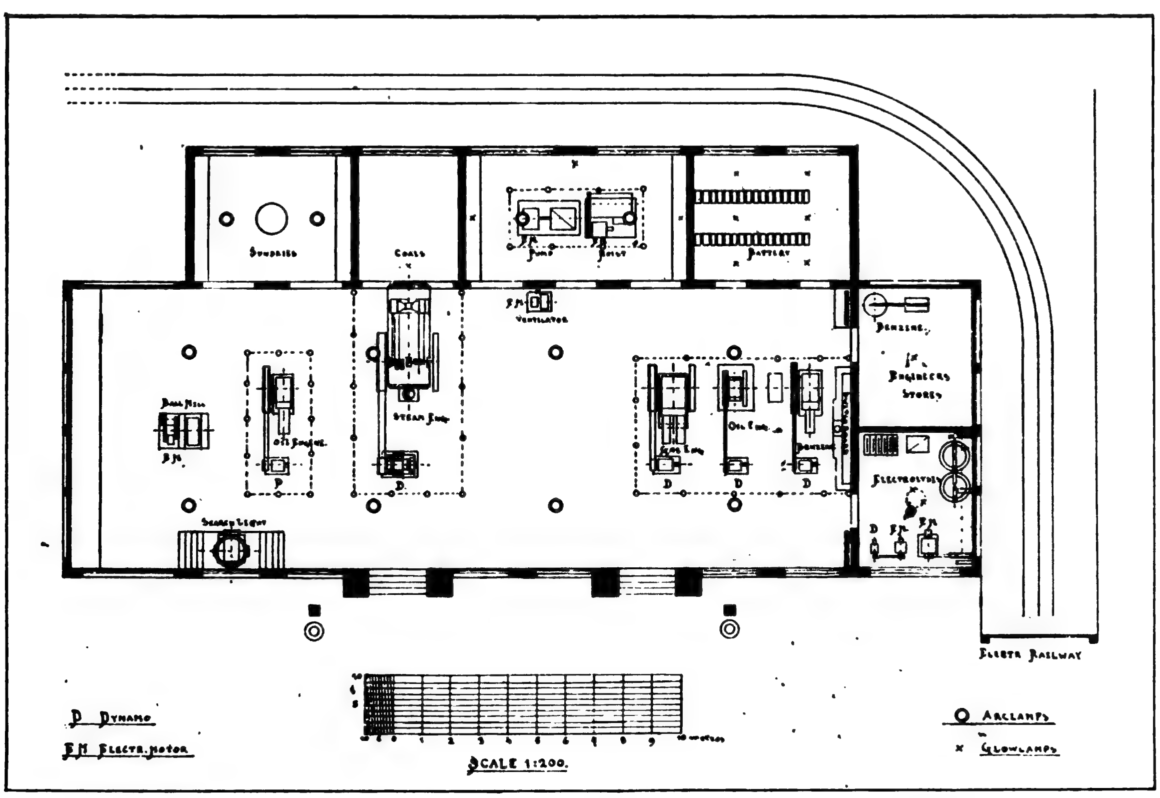


Fig. 4.—Diagram of the Schuckert Electrical Mining Exhibit.

The electrolytic process mentioned before was shown in a separate part of the building (see Fig. 4). The necessary shafting used for driving an air and acid pump, besides two stirring apparatuses, was driven by an electric motor, while the low voltage current necessary for electrolysis was furnished by a small dynamo, also driven by a separate electric motor. This electrolytic process, which was operated according to patents belonging to Dr. Höpfner, of Giessen, Germany, consists mainly in the use of a solution of low-grade copper or silver-ores, the metal of which is deposited electrolytically in plate form in a chemically pure state, the electrolyzed remaining liquid being used over again for working a certain quantity of fresh ores. The process by these means forms a complete cycle, involving a minimum of working materials and of cost.

The two search-lights mentioned, one of which was located on top of one of the handsomest exhibition buildings, shown in Fig. 1, furnished no little amusement and delight, when illuminating the romantic "Cerro Santa Lucia," at the other end of the town, or when their strong beams rested on the distant heights of the Cordillera.

A very interesting use of the storage battery for mining purposes was shown in the form of a portable lighting apparatus for mine drifts. The battery consisted of 10 small Tudor cells, filled with Dr. Schoop's well-known gelatinous electrolyte, enclosed in a box carrying the necessary switches, fuses and charging connections, the whole apparatus forming a sort of knapsack on the back of a workman. A 16 c. p. lamp which is connected to this battery by a strong metal-sheathed flexible cable is enclosed in a strong wire-guarded metal reflector, and will burn for about 10 hours.

Besides this splendid exhibit, the largest and most complete, electrically, in the Exposition, Messrs. Saavedra, Bénard & Co. had a smaller power-house for themselves including a 30 h. p. Deutz single-cylinder engine driving a Schuckert dynamo of 21 kilowatt, which was used exclusively for lighting the different avenues, buildings, festivities, etc., in the park and which of course necessitated a frequent shifting of lamps and wires. Altogether there was running an aggregate of 125 h. p. including electric motors, which furnished current for about 70 arcs ranging from 300 to 3,000 c. p., and 24 16 c. p. incandescents. The complete plant was started the evening of the opening day, being the only one ready, and ran till the end of the exhibition without a hitch. The designs and plans for this exhibit besides the erection of the complete plant were in the hands of the writer, who acted as electrical engineer to the firm.

THE SHUNT vs. THE DIFFERENTIAL ARC LAMP.—II.

(Concluded.)

BY

E. R. Knowles. C. E.

Now as to the circuits and sources of electric current upon which these lamps will successfully operate.

We may have several kinds of electrical circuits upon which it may be desired to run electric arc lamps. We may have a circuit in which the current and electromotive force are constant; we may have a circuit in which the electromotive force is maintained constant and the current is varied; or we may have a circuit in which the electromotive force is varied and the current maintained constant. The two latter are the ones met with in actual practice.

It is necessary for the satisfactory running of an arc lamp, that as the current passing through it varies, the electromotive force between its terminals shall also vary inversely with the current variations, these variations together making the relative constancy of action of the lamp. At its best no lamp runs with absolute constancy. There is always a fluctuation up or down of the current and there must be corresponding fluctuations down or up of the electromotive force, and the smaller and more frequent these variations are made the more nearly constant will be the action of the lamp. To accomplish this there must exist in the circuit an ability to vary its electromotive force within limits; there must exist a spring or elasticity, as it might be called, to the circuit.

At first the only source of electricity was galvanic batteries which were coupled together in such manner as to produce the required electromotive force and current. This arrangement was always of constant electromotive force, the current varying with the resistance in the circuit. The earlier types of main and shunt lamps were operated on such circuits with no very satisfactory results, except as they were run singly.

Any lamp with a reasonably well made feeding mechanism will run singly on any circuit, but when two or more are to be run in series on the same circuit, something more is required. The lamp must not alone be capable of quickly adjusting itself to variations of current, but there must be present the spring or elasticity to the circuit already mentioned, so that it will also adjust itself to the varying conditions upon it. No such conditions prevail on a circuit whose source of current is a battery. Its electromotive force is fixed and does not vary and when more than one lamp is run on such a circuit they do not give the best results. There was no chance for the electromotive force to vary and there was no spring or elasticity, so that the lamp ran in a more or less irregular manner even under the best conditions. With the advent of the dynamo electric generator, a change in conditions took place and circuits of constant current and varying potential were made available and it became possible to run any number of arc lamps in series upon such a circuit, as it possessed the requisite elasticity or ability to vary its electromotive force. Shunt lamps were so run, but the most successful lamps were those of the differential type. The current was kept practically constant on the circuit and the electromotive force was varied with the number of lamps or the total electrical resistance of the circuit.

Now it is perfectly possible to so adjust the balance of a differential arc lamp, the pull of the main magnet balanced against the pull of the shunt magnet, that the lamp will quickly adjust itself to the variations of the current and electromotive force and maintain a practically constant arc and so a practically constant resistance between its terminals. This being the case each lamp works as an entity in itself and does not influence, nor is it influenced by, any of the other lamps which may be running in series with it. This being so, all the lamps will operate alike and all will, if properly constructed and adjusted, have practically the same length of arc and will each give practically the same light.

Recently, in order to cheapen and simplify the arc lamp, a return has been made to the second or shunt type of lamp. It is not possible, however, to make these lamps operate in as perfect a manner in series as the differential type of lamp. The differential type of lamp is very sensitive to slight changes in the current on account of the double magnetic action to which it is subjected, but the shunt lamp has only one magnet in action, and is sluggish and does not respond as quickly to slight changes in the current, so that its resistance may vary greatly and allow one lamp to gain or lose on its neighbor, so that some lamps may be giving more light than others on the same circuit. This action is not very noticeable on circuits where the electromotive force can vary with the resistance of the circuit as in this case the distribution of electromotive force along the circuit will vary and where a lamp may have an abnormally long arc the e. m. f. between the lamp terminals will rise and the action of the shunt be greatly increased and so be brought more strongly into action and thus cause the lamp to adjust itself more

quickly to its normal condition. Until quite recently all arc lamps were run on such a circuit, the one in series with the others, like beads on a string, constituting what is known as the high potential series system of lighting.

With the recent wide-spread introduction of the incandescent lamp, new conditions have arisen. We have a return to the old constant E. M. F., varying current circuit, all of the incandescent lamps being arranged singly in parallel with one another like the rungs of a ladder; the difference between the modern circuit and the old circuit being that the modern circuit is supplied from a dynamo electric generator and not from a galvanic battery and that a higher potential is used so as to permit of a much more extended and economical distribution of current. It is also desired to run arc lamps on the same circuit with the incandescent lamps so as to render the lighting service as universal in character as possible. If the potential of the circuits was low enough to admit of the running of each arc lamp singly there would be no difficulty; almost any lamp would serve the purpose; but it is not. At least two arc lamps must be run in series. The circuit being constant in potential, the old original difficulty crops up again, namely, the lack of spring or elasticity to the circuit due to the unvarying character of the E. M. F.

The E. M. F. of the modern constant potential circuit was found to be too high for two lamps in series, so it became necessary to place a dead resistance in series with the two lamps to take up the excess of potential and it was then found that two lamps of proper construction would run satisfactorily in series on such a circuit. This was due to the fact that although the potential at the terminals of the lamp circuit was *constant*, the dead resistance introduced the needed spring or elasticity into the circuit, because, as the resistances of the lamps varied, a constant *shifting* of the *distribution* of the potential on the circuit took place, it being shifted off and on the dead resistance, so to speak, permitting of the slight variations of E. M. F. at the lamp terminals necessary to the satisfactory running of the lamps.

At first the differential type of lamp was used on these circuits with most satisfactory results, provided the lamps and the dead resistance were all properly proportioned to one another. When this was not carefully attended to, there was a tendency for one lamp to rob the other and for the lamps to see-saw, due to the causes already described. But as the demand for this style of lighting increased, the number of different makes of lamps also increased, and close competition in prices set in, with the result that the price of lamps was gradually forced down. As the price went down the quality of the lamp went down with it. It was made less substantial and everything was eliminated from it that could possibly be spared without seriously impairing the running qualities of the lamp.

Finally a return was made to the old form of a single magnet shunt lamp as being the simplest and cheapest form of lamp to build. But with the return to this form of lamp, all the original evils of such a lamp returned and the action of the lamps became unsteady to a marked degree, the lamps robbing and see-sawing, not quite as badly as in the old times on the battery circuits, because the dead resistance in circuit with them helped to obviate this in a measure, but badly enough to make their action quite unsatisfactory and all due to inherent defects already described in this form of lamp, which can never be fully eliminated.

It would seem, from all the available data on the subject, that the differential type of lamp is the best form of lamp for all arc lighting purposes, and especially so for use on circuits where the terminal E. M. F. is kept practically constant, and is the only type of lamp which gives a practically constant and steady light, and that the shunt form of lamp possesses radical and inherent defects which render it unsatisfactory in operation in any circuit, but especially so on modern constant potential circuits. A little better mechanism and a little more first cost; a little less profit to the seller and a return to the differential type of lamp, would give the public that which they desire, a better and more satisfactorily running lamp than many of those now in use.

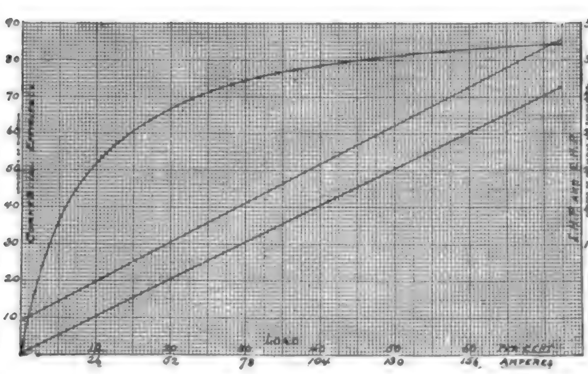
A great many ingenious forms of feeding mechanism have been devised, many of them exceedingly simple and beautiful in their arrangement, but the difficulty does not lie in this direction, it lies in the magnetic devices which control the feeding mechanism and experience would seem to point out that the type of lamp which is most free from all difficulties and which most nearly fulfills the requirements of a steady, quiet, unvarying lamp is of the differential and not the shunt type.

SOME OBSERVATIONS ON A DIRECT-CONNECTED 300 K. W. MONOCYCLIC ALTERNATOR.[1]

BY DUGALD C. JACKSON AND S. B. FORTENBAUGH.

The machine is the new monocylic alternator, manufactured by the General Electric Company, of 800 K. W. capacity—1,150 volts, 260 amperes—at a speed of 140 revolutions per minute. It is direct connected to a Russell, tandem-compound, high-speed condensing engine, which ran during the test about 15 revolutions more than the required speed. The armature is of the ironclad type, 110 inches in diameter, 10½ inches wide, with about $\frac{3}{16}$ inch clearance, and is furnished with two sets of windings. According to Dr. Louis Bell the cross-section of the main and teaser coils is the same, but the latter has fewer turns and is placed in shallower slots midway between the main coils. The pressure developed by the teaser coils was .7 of the pressure across the main terminals of the machine.

In planning the test we fully expected to make a ten hour, continuous run at full load, and determine the heating, efficiencies, etc., but were unable to go farther than slightly above half load. In the first place the engine was piped to a single boiler of insufficient capacity, and secondly, the engine was too small to carry the full load of the generator, and in addition its regulation was defective, the total variation of speed being as much as 15 per cent. Fig. 1 therefore shows an efficiency curve for slightly



EFFICIENCY CURVES OF 800 K. W. MONOCYCLIC ALTERNATOR.

above half load, and from this it will be seen that the commercial efficiency of the generating set is about 81 per cent. at half load. When these observations were made the machine was in commercial service with the regular transformer load. The commercial efficiency of the generating set is taken as the ratio of the electrical output to the I. H. P. The E. H. P. here used is taken as the product of amperes and volts, the power factor of the circuits therefore being assumed at 100. Actual measurements have shown that the power factor is at any rate over 98 per cent., and consequently the error made by this assumption is comparatively small. The diagonal lines in the figure show respectively the I. H. P. and the E. H. P. at different loads, the vertical scale for these being at the right hand of the figure. For the ordinary changes of load, the regulation of the alternator is not entirely effected by the series coils as the machine now stands, but requires considerable hand regulation. However, this can probably be improved by altering the shunts across the rectifier and series turns respectively, thus giving a greater number of ampere-turns in the series coils. This lack of regulation on the part of the alternator combined with the unsatisfactory regulation of the engine makes the performance of the generating set somewhat below the standard for this class of machinery when under ordinary working conditions, but, as a whole, the unit is a magnificent piece of mechanical construction.

1. Abstract of a paper read before the Amer. Inst. of Elec. Engrs., Niagara Falls, June 26-30, 1895.

LOCATION OF GROUNDS IN ARMATURES, FIELDS, ETC.[1]

BY CLARENCE E. GIFFORD.

If the work can be performed in a very quiet room, two or three cells of battery, a telephone receiver and connecting wires, comprise the necessary apparatus. In some cases two "table binding posts" and a foot or two of No. 18 or No. 20 bright iron wire will be a convenient addition. Where noise will not permit of the use of a telephone, a dead-beat reflecting galvanometer, a milli-voltmeter, or some other form of delicate and rapid working visual indicator must be used instead. If an armature is to be tested without removing it from the machine, connection with the battery may be made through the brushes, first making certain that the short-circuiting switch is open, if dealing with an arc machine. The points of connection with the battery need not be diametrically opposite, and may be made by the wires being firmly pressed against the commutator by an assistant, if more convenient.

Good electrical contact between metallic surfaces can better be secured by cleaning the same thoroughly with kerosene, which removes foreign matter, and is so fluid that it will in no way interfere with perfect contact, when moderate pressure is applied. Especially when making measurement of resistance of armature sections, it is even advisable to have the surface of the commutator quite wet with kerosene during the operation, as this avoids trouble from grease or dirt which might get on the surface from handling, subsequent to cleaning, and it also prevents the contact points becoming oxidized by any sparks which may occur at the moment of breaking contact. True, the oil is an insulator, but we use it in this case as a detergent simply.

Connection being made between battery and commutator, first determine whether the armature circuit is complete throughout. If the circuit is complete, a click will be heard in the telephone when the two terminals of the same are brought in contact with any two contiguous bars of the commutator, or when contact is broken. If an open circuit exists on either side of the circuit, of course no sound will be heard in the telephone when used on that side, except when connection is made or broken by it between the bars lying on opposite sides of the break. See Fig. 1.

Close any open circuit temporarily by bridging between the two bars with a drop of solder. Two or more breaks can evidently be located by suitably shifting the battery contacts and searching as before. Open circuits will, of course, when an armature continues in work, soon cause burns between the bars that will indicate unmistakably their location. Having closed any open circuits, and the battery being connected to two points of the commutator, approximately opposite each other, one terminal of the telephone is connected to the armature shaft, or frame of the machine, and the other terminal is drawn completely around over the surface of the commutator, while the telephone is held to the ear. If

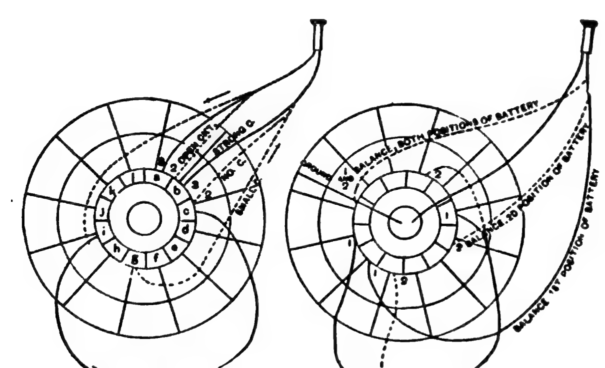


FIG. 1. FIG. 2.

only one ground exists, two balancing points, or points giving the least noise in the telephone will be found.

In an armature of ordinary construction, one of the points so found will be on the bar nearest the real ground, while the other balancing point bears what might be termed a "bridge relation" to the first, being at practically the same potential; the armature itself forming in reality a veritable Wheatstone bridge.

Now, shift the points of battery contact a few bars either way and the true ground, if but one exists, will be indicated in precisely the same position as before, while the other balancing point will shift every time the battery contacts are shifted. See Fig. 2.

If two grounds exist, two balancing points will be found, as before, but both points will shift more or less when the battery contacts are shifted, provided the grounds lie on opposite sides of the same battery contact.

In the case of one ground, having determined its location approximately, fix it as closely as may be by making and breaking contact with the telephone terminal on each of the more quiet bars, separately, until by comparison, the two giving the faintest clicks are determined. If your hearing has served you correctly these two bars lie nearest the trouble, the fainter one being the nearer. Prove the non-existence of a second ground by placing one of the battery contacts on the first bar to the right of the apparently permanent balancing point just found, and then on the first bar to the left of said point, the other contact being nearly diametrically opposite. This balancing point should still remain unchanged if no other ground exists.

The next step is to connect the battery to these two bars just

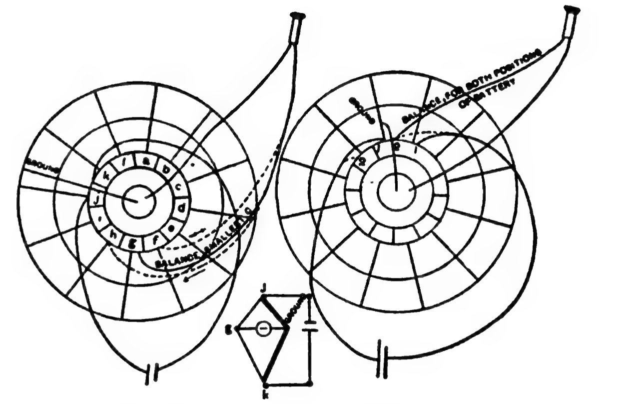


FIG. 3. FIG. 4.

fixed upon as lying nearest the trouble. The armature still forms a "bridge," the portion included between the two contiguous bars to which the battery is now connected forming the one side, and the remainder of the armature, the other side. See Fig. 3.

One of the telephone terminals is now connected to the shaft as before, and the other terminal again drawn around the commutator. If the balancing point is found, say one-sixth to one-half, the long way around from one battery contact to the other, (these contacts being on two contiguous bars) the trouble lies in the coil between those two bars, and the point of trouble divides the coil in the same ratio as the balancing point divides the remainder of the armature, the ground and the balancing point being respectively nearest the same battery contact. If the balancing point falls on the same bar as one of the battery contacts, the ground is located on that bar or on the lead between it and the armature, provided the balancing point is found to be upon the same bar when the battery contacts are both shifted one bar to the right or left of their original position. See Fig. 4.

If the balancing point appears to be found within three or four bars from one of the contacts, the precaution should be taken to test its correctness by moving both battery contacts one bar toward the balancing point. If the trouble was between the battery contacts when in their previous position, this shifting of the contacts will now throw the balancing point clear around onto the contact which was, in the previous position, farthest away from the balancing point. If, on the contrary, the balancing point remains unmoved by this shifting of the battery contacts, it shows that this balancing point is the point nearest the real ground, and that the ear was deceived in its first supposed approximation, which, with due care, however, is not likely to occur.

If such error has been made, the new point, as indicated, together with first the bar on one side of it, and then on the other, must be tried as points of battery contact; or, much better, make a new start with the contacts nearly at opposite sides of the commutator and proceed as before. A single 20,000 ohm ground on a one ohm armature should be located accurately in not over three minutes, in a quiet room. High resistance grounds require more battery and more care. Armatures of very low resistance also offer greater difficulty.

Where two grounds are found to exist, as indicated by the change of location of both balancing points, under the conditions before stated, when the battery contacts are shifted, the following mode of procedure will answer the purpose well, and is simple. Fix the battery contacts at any two points of the commutator nearly opposite each other, preferably at points to be determined by trial, that will cause the balancing points to fall nearly diametrically opposite to each other, and determine and mark the two balancing points, as then shown. Now place the battery contacts on the balancing points just found. If only one ground exists, the two balancing points and one battery contact will all be coincident in one point. If two grounds exist, both balancing

1. Abstract of a paper read before the American Institute of Electrical Engineers, Niagara Falls, June 26-30, 1895.

points will be shifted from their former position. Open the armature circuit by unsoldering one of the ends of a coil connecting with the lead of the bar that is marked in the first part of this test, as one of the balancing points. Place one of the battery contacts on the armature shaft, and the other on the marked balancing point that is farthest from the point where the circuit has been opened. Next place one telephone terminal on the first bar to the right of the opened wire, and draw the other terminal from the same point, toward the right, over the surface of the commutator. The telephone will be absolutely silent until the moving terminal has just passed the ground nearest to it, and strikes the first bar beyond the same, when it will click. This ground lies in the coil between this first bar giving a click and the one passed just previously, or else in the said previous bar.

The other ground is obviously to be located in a similar manner, by placing one telephone terminal on the bar just to the left of the open wire, and from that point searching toward the left with the other terminal. Only in cases where one ground is of very low, and one of very high resistance will any difficulty be experienced in locating both accurately before either is removed.

The coils thus indicated may have their terminals unsoldered, when it can be readily ascertained with each, whether the ground be in the coil or in the bar just preceding it.

If scientifically inclined, or if otherwise preferable, the circuit may be opened at a point somewhere midway between the two indicated coils instead of disconnecting those coils, and the exact location of each ground determined as follows: Take a piece of "broom wire" about 18 inches long, new and clean, screw the ends firmly into two clean, brass table binding posts, and into the other holes of the same posts, screw the battery terminals. Have an assistant press the corners of the bases of the binding posts into very firm contact with the two bars that lie at the ends of the indicated coil, observing the directions previously given for securing clean contact. Place one telephone terminal in contact with the shaft, and with the other find the balancing point on the wire. This point will indicate the relative position of the ground in the coil, or commutator bar, as the case may be. If more than two grounds were suspected, the two lying the farthest apart would be approximately located by the first part of the two-ground process, and if these coils were not disconnected before proceeding farther, it would be well to make two openings in the circuit, close to and lying between these outer grounds; then locate definitely these two extreme grounds, and proceed with the remaining section somewhat as with a complete armature, except that you would commence by connecting the battery to the terminals of this section, and would then bridge the telephone from the shaft to the different portions of the section, and would complete the process by applying the remainder of the two-ground test.

In dealing with a cross connected Gramme ring, an obvious change would be made in the points of application of the battery; and as many points of apparent trouble would be indicated as there were series of cross-connections.

After location of these points it would be necessary to use the auxiliary wire loop, as before described, between these points, to determine which is nearest the trouble. This fact being determined, it would in case of a single ground (indicated by the permanency of the balancing point) become necessary to remove the cross-connections from two bars before proceeding farther. The auxiliary wire loop would properly be used to complete the process.

The ordinary "closed coil" ring or drum armatures are types to which these methods are directly applicable.

The sections of open coil armatures would receive the same treatment as field coils.

Whenever necessary to deal with wet grounds in testing, it is better to make at least four tests, reversing the battery after each test, and taking the mean of the four determinations.

Field coils, also any wires of uniform cross-section, the extremities of which are accessible and within a reasonable distance of each other, can of course be easily tested for grounds by soldering or firmly clamping a bare wire of suitable size between the extremities of the conductor to be tested, applying a battery to the junctions, and bridging with a telephone between the bare wire and the object upon which the conductor is grounded. This will give only the location of a single ground, or the "resultant" of two grounds. A "T.-H." rheostat should have the battery connected to the two extremities, and the point of apparent ground determined by bridging with a telephone between the frame and the several contact plates. Then apply the battery to the frame and point of apparent ground, connect one terminal of the telephone with each extremity successively, and search from it toward the center with the other terminal, as in the case of searching for two grounds in an armature.

In determining the location of grounds that are of very low resistance, a good induction coil similar to that used in the Blake transmitter may be used with advantage in connection with the telephone receiver. The receiver is placed in circuit with the secondary of the coil, and the "bridging" is done with the primary. With high resistance grounds the best results are obtained by using the receiver only.

THE CAUSE OF DEATH IN ELECTRIC SHOCK.[1]

BY A. M. BLEILE, M. D.

The data bearing on the subject in general are quite meagre, especially as to the amount of current which actually passed through in fatal cases. In all my experiments dogs were used.

In the first experiment 525 volts, 2 amperes were applied for 8 seconds; in the second, 220 volts, 1.2 amperes; in the third, 106 volts, .4 ampere, 10 seconds; in the fifth, 96 volts, .35 ampere, 2 seconds; in the sixth, 52 volts, .3 ampere for 1, 2 and 4 seconds; in the seventh, 70 volts, .32 ampere, ½, 1 and 2 seconds was used.

Before the application of the current a canula was put into the trachea so arranged that it could at once be connected with a bellows for the purpose of giving very complete artificial respiration. Respiration was set up as soon as the current was off and this was continued for periods varying from 20 minutes in the first case to 2½ hours in the last, and in no instance was resuscitation accomplished. Further work was carried on for the sole object of studying the effect of the current.

The result depends, somewhat independently of the weight of the animal, on three factors: On the voltage, on the amperage and upon the time of the application. A variation of either one of these factors may change the result—that is, a lower voltage with lesser amperage applied for a longer time will have the same effect as a current of higher voltage or more amperage applied for a shorter time.

In all cases this examination was made immediately after death, and at first we wished to study the changes produced upon the heart, so that the incision was made through the chest walls and the heart exposed as rapidly as possible. This organ presented the following peculiar conditions. The left side was completely relaxed, the right side was intensely gorged with blood, as were also the large veins in the immediate vicinity of the heart, and the little appendages of the upper portion of the heart were found beating regularly, strongly and synchronously. Pressure on the heart caused a contraction of the other parts, and from this it was evident the death was not due primarily to the destruction of the heart fibers. In addition it was noted that the deep and extensive cuts made in the tissues were free from blood, and that the arteries were quite small and contracted. This excluded a direct effect upon the heart, and, having shown by artificial respiration that the stoppage of this function was not the cause of death, other causes were to be looked for.

It was supposed that the current immediately struck the pneumogastric nerve stimulating those fibres which control the heart in that they have the power of arresting its beat, when strongly stimulated. To test this view, resort was had to the hypodermic injection of atropine, the action of which drug is to paralyze the nerve fibres and thus prevent their action on the heart when stimulated. The animals were not rendered more resistant by the drug, and the theory as to the role of the pneumogastric nerve was abandoned. To test the view, that the action of the vascular nervous system was the cause of death, we resorted to the hypodermic use of nitroglycerine. It is known of this drug that it powerfully affects the arterial system, causing, when given in larger doses, an extreme dilatation of the arteries, and a consequent great lowering of the blood pressure.

The first animal received $\frac{1}{15}$ of a grain of nitroglycerine and, when the effects were fully established, a current, which was known to be fatal, was thrown in; namely 50 volts, .24 ampere for 4 seconds, but the effects produced by this current soon passed off and there was complete recovery. Then 97 volts, with .54 ampere were thrown in for 1 second but this caused death. The animal was then brought moderately under the influence of the nitrite of amyl, (a drug having a similar action to nitroglycerine) 52 volts with .24 ampere were thrown in for 3 seconds, (this by the way being a fatal dose ordinarily,) without producing death. Fifty-two volts, .25 of an ampere for 4 seconds, also a fatal dose, failed to produce death. Fifty-two volts, .3 of an ampere for 6 seconds produced death, but after the current was taken off, the animal made 22 deep, regular respirations though not a trace of the heart beat could be made out, this incidentally proving that stoppage of the respiration is not the primary cause of death.

No. 24 was a pointer dog in excellent condition, weighing 34 lbs. Nitrite of amyl was given until the effects were fully marked. Fifty and five-tenths volts with .2 ampere were given for 3 seconds; after a pause the same quantity was given for 6 seconds, followed by recovery. Three days later the same dog, who showed no effects at all of the previous treatment, was given—without the nitrite of amyl—51 volts, .2 ampere, 4 seconds, producing death.

The statements made in regard to the cause of death by electricity are so at variance with one another that it is unnecessary to review them here. Among other plausible reasons it has been stated that the current has a direct disintegrating effect on the brain and nerve tissues and that herein is to be found the cause of the fatality. The disintegrating effects of the current on the

1. Abstract of a paper read before the Amer. Inst. of Elec. Engrs., Niagara Falls, June 26-30, 1895.

brain and nerve tissue said to follow are not to be seen microscopically and the microscopic examination of these organs so far as made by us failed to reveal any change in their structure. It would appear therefore that death in electric shock is entirely due to the fact that the current produces a contraction of the arteries through an influence on the nervous system, and that this constriction of the arteries throws in such a mechanical impediment to the flow of the blood as the heart is unable to overcome, and that, where drugs are given to counteract this effect, much larger doses of electricity than the ordinary can be borne. While artificial respiration may be of value in simple stunning, when larger doses have been taken, no rational means of resuscitation have as yet been suggested.

The current was obtained from a surface wound alternator giving an approximate sine-curve.

PROPERTIES OF FUSE METALS WHEN SUBJECTED TO SHORT CIRCUITS.[1]

BY WALTER E. HARRINGTON.

The law bearing on the relation existing between the diameter of fuse metals and the minimum currents required to fuse the metals, when sufficient time elapses for the fusion to occur, as enunciated by Preece, Forbes and others is $C = a\ d^{\frac{3}{2}}$ where C = Current in amperes, d = Diameter of wire in inches, a = Constant depending on the metal.

The law is not rigorously true but can be depended upon very closely, particularly in the smaller diameters. In the larger diameters the law certainly does not hold true, as has been shown by different observers.

In the course of his professional work the writer has had occasion frequently to desire to know what current would flow through fuse metals on 500-volt short-circuit work. There being absolutely no literature on the subject and the data being obtained only by experiment led to the following series of tests:

The sizes of fuse wires employed was such that the current flowing through them would not exceed 500 amperes, this being determined by the adjustment of the Westinghouse magnetic circuit breaker employed.

In the following tables the first column gives the size of wire in B. & S. gauge; the second column gives the circular mils. The third column gives the mean of determinations as given by the indications of the C-S magnetic circuit breaker. The fourth column gives the constant B entering into the formula $C = B\ d^2$, where C = current in amperes passing through the fuse metal on a short-circuit. d = diameter of fuse metal in inches. B = constant depending on metal and voltage of circuit short-circuit is made on.

TABLE I.

COPPER.

B. & S. Size Gauge.	d^2 C. M.	S. C. Amps.	B.
30	100	39	390,000
29	126	44	350,000
28	159	62	390,000
27	201	80	398,000
26	254	116	456,000
25	320	140	437,000
24	404	225	556,000
23	509	300	589,000
22	642	370	576,000

By averaging B the law for copper wires on 500-volt short-circuits could be stated to be: $C = 460{,}000\ d^2$; or, expressed directly in terms of circular mils, the current which will flow in copper wires on 500-volt short circuit will be:

$C = \frac{C.\ M.}{1.9}$, where C = current in amperes, C. M. = circular mils.

TABLE II.

ALUMINUM WIRE.

Size B. & S. Gauge.	C. M. d^2.	S. C. Amperes.	B.
24	404	200	500,000
21	810	290	358,000
20	1021	325	318,000

For aluminum the law for 500-volt short-circuit currents would be: $C = 392{,}000\ d^2$; $C = \frac{C.\ M.}{2.6}$.

There was one very pronounced peculiarity in the action of aluminum during the short-circuits; the metal seemed to burn longer and pieces of metal would come down after the explosion, still burning.

TABLE III.

STOCK (LEAD AND TIN) FUSE WIRE.

Size B. & S. Gauge	Rating Fuse Wire Amperes.	C. M. d^2.	S. C. Amperes.	B.
24	1	404	50	125,000
21	3	810	115	156,000
19	5	1252	130	106,000
17	7	2048	230	118,000
15	10	3256	290	86,000

For fuse metal (ordinary commercial lead and tin alloy) the law for 500-volt short-circuit currents would be: $C = 118{,}000\ d^2$; $C = \frac{C.\ M.}{9}$.

Copper gave the best result as regard quantity of current per cross-section of metal. This is shown in the formula for copper

$$C = \frac{C.\ M.}{1.9},$$

where, compared to the other metals, the current per circular mil is a maximum, and that the amount of metal to disintegrate for a given current would be a minimum. In all the tests the behavior of the copper short-circuits was noticeably short and attended with a loud explosive report, with but little comparative flash.

In the use of the law for practical work where fuses had to be employed for cases beyond the values as determined by test, the values as obtained by extrapolation in every instance fulfilled the requirements, demonstrating the practical correctness of the law.

TABLE IV.

LAW.

B. S. Gauge. Cap.	Circular Mils.	PREECE. Regular Amperes Rating.	HARRINGTON. Amperes Short Circuit.
30	100.5	11	39
29	126.7	12	44
28	159.7	14½	62
27	201.5	17	80
26	254.0	20	118
25	320.4	24	140
24	404.0	29	215
23	509.4	34	298
22	642.7	41	340
21	810.1	48	405
20	1021.5	56	510
19	1252.4	67	625
18	1624.3	82	812
17	2048 2	98	1024
16	2582 9	115	1291
15	3256.7	140	1625
14	4106.8	168	2053
13	5178.4	195	2589
12	6529 9	235	3264
11	8234 0	280	4167
10	10381.0	330	5190
9	13094 0	395	6547
8	16509.0	470	8000
7	20816.0	560	10000
6	26250.0	670	13000
5	33102.0	790	16000
4	41742.0	950	20000

In Table IV, column 1 gives the size in B. & S. gauge of the copper wires; column 2 gives the circular mils; column 3 gives the minimum fusing current as determined by Preece's law, $C = 10244\ d^{\frac{3}{2}}$, and column 4 gives the fusing currents on 500-volt short-circuits as determined by the law, $C = 470{,}000\ d^2$, enunciated by the writer. The natural conclusion arising from a knowledge of the above data is that fuse metals are under no circumstances to be considered in the light or nature of a protection.

1. Abstract of a paper read before the Amer. Inst. of Elec. Engrs., Niagara Falls, June 26-30, 1895.

MUNICIPAL LIGHTING AT SPRINGFIELD, ILL.

At Springfield, Ill., an interesting experiment in municipal electric lighting has been started. As the debt of the city was up to the legal limit, no obligation could be incurred for the establishment of a municipal plant. Sixty men of property loaned their credit to the city, and a lighting plant has been set up. It has been leased to two electricians for five years on a contract to supply the city with light at $60 a lamp. Appropriations will be made by the city at the rate of $113 a lamp, and the difference turned into a sinking fund, which will extinguish the debt incurred in five years. Then the city expects to run the plant itself.

ELECTRIC TRANSPORTATION DEPARTMENT.

THE SUBSTITUTION OF ELECTRICITY FOR STEAM IN RAILWAY PRACTICE.[1]

BY DR. LOUIS DUNCAN.

In an address delivered before this Institute in June 1892, Mr. Frank J. Sprague spoke of the coming development of electricity as applied to railways, and outlined his views as to the direction of this development. In the last three years great extensions have been made in electrical transportation, and it seems well to review briefly the amount of these extensions and their direction. In this paper I shall consider electric traction as it stands at present, not the possibilities of the future.

In the last seven years electricity has largely taken the place of horses for tramway work, and it is now beginning to replace cables, although the latter have been recently installed at great expense. At first the lines were confined to the limits of towns and cities, but they have been extended first into the suburbs, and then to neighboring towns, and the extensions have brought them in competition with the steam roads. The reports of the earnings of the Railroad Companies in the United States, shows that after paying fixed charges, only a small amount of the net profit remains to be applied to dividends on the stock. Any general decrease in the earnings even if it is only a small percentage of the total amount, will wipe out the narrow margin that is now applied to dividends, and the absorption by the electric lines of the local travel formerly conducted by the steam lines promises to do this. At first the managers of the larger steam roads ignored the growth of their electrical rivals, but the time has come when they can no longer ignore the decrease in the receipts from their local passenger travel, and they are beginning to face the difficulty and to carefully study the situation.

In this paper I will briefly take up the following questions:—

1st. Given a railroad system at present operated by steam: will it pay to change entirely to electricity, or to make a partial substitution, and how should the change be made?

2nd. If entirely new lines are to be built, is it likely that it will pay to equip them electrically, and how should they be equipped?

3rd. I will describe the equipment of the B. & O. Tunnel Plant and draw from it what morals I can.

In order that it should pay a railroad to make a change in its motive power, the effect of the change must be either to increase the receipts or decrease the expenses by an amount equal to the interest on the cost of the change. That is, there should theoretically be such a gain; practically, the amount should be greater in order to justify the change, to take into account those elements not capable of exact calculation, and also the fact that an increase in the fixed charges of a road is a more serious matter than the mere amount of it, for although the average for a number of years might show a gain by the substitution of electricity, in a bad year the increased fixed charge might cause difficulty.

There are two very distinct sides to the question of transportation, the passenger side and the freight side, and their requirements for good service are very different. First, taking up the question of passenger travel, the receipts of a road are increased by running trains at short intervals and at high speeds, and this is a condition peculiarly favorable to electricity. On an electric line short trains equally distributed over the track, give a greater station efficiency, and the lowest cost of equipment of both station and line. The cost of train service is somewhat greater, but is compensated by the saving in the other items.

The cost of hauling a given number of passengers between given points by steam is greatly increased when the number of trains is increased. The efficiency is less, and the cost of equipment and of train service is greater. Wellington states that doubling the number of engines for a given traffic, increases the cost of transportation about 50%.

On the other hand if we take up the question of freight traffic, the conditions of greatest economy are reached when trains of a maximum weight are hauled by a single locomotive. The tendency in late years has been in the direction of increasing the size of the locomotive, the capacity of the cars and the length of the trains. These changes have necessitated more solid and expensive road beds, heavier rails, and general strengthening of bridges. The outlay has been enormous, but the decreased cost per ton mile for freight transportation has shown the wisdom of the change. On one of the larger roads which publishes careful yearly statistics, I find that the cost of transportation per ton mile in 1870 was 1.15 cts. and in 1890, .56 ct., on another road it was 1.9 cts. in 1864 and .447 ct. in 1893. The number of tons per train mile on the first road in 1870 was 103, while in 1890 it was 226. In attempting to carry on traffic of this kind by electrical locomotives operated from a central station, we find that we are at a great disadvantage because of the irregular service necessitated by the freight traffic and the unequal distribution of the load along the line. Suppose for instance that there were two stations supplying the line and that the traffic was uniformly distributed along it, then the capacity of each station would be one-half of the total required capacity. Suppose, however, that the entire traffic was concentrated in one train, then each station would have to have a capacity equal to the total power required for hauling the entire traffic, as the train would be first supplied from one station, and then from the other. The line also would have to have a capacity suitable for handling the total traffic. If a number of heavy trains were used, and the traffic was irregular and liable to be congested at one point as in the case of freight service, then again the capacity of the stations would have to be greater than that required to supply one-half of the normal traffic. If we were to decide to transmit the current to a longer distance and to supply all the track from one station using transformer devices along the line, then the capacity of the station itself would only be that required for the normal traffic of the line, but the transformer devices would have to be sufficient to handle the maximum traffic of the section which they supplied, and would have to be given a capacity greatly in excess of their average load in order to supply this energy. We must distinctly bear in mind in considering the application of electricity to steam roads that any departure from a uniform distribution of load along the line will increase both the cost of equipment and the cost of operation.

In looking over the reports of the same road from which I have given freight statistics, I find that in 1870 the receipts per passenger mile were 2.09 cts. while the expenses were .59 ct. In 1890 the receipts were 1.9 cts. while the expenses were 1.47 cts. During this period the passengers per train mile have decreased from 79 to 59. Comparing these figures with those given for freight transportation, we find that the two types of traffic have gone in opposite directions in the period we have been considering. The amount of freight transported per train mile has more than doubled, and the expenses have decreased more than one-half. The passengers per train mile, on the other hand, have decreased, and the expenses have changed only a slight amount, notwithstanding the greater economies that have been put in force in the interval. Passenger traffic has come in the direction in which electricity is the most economical for transportation; freight traffic, on the other other hand, has gone in the direction where electricity becomes most costly. It might be argued that some new scheme for freight transportation by electricity might be used, but it would be difficult to devise any system more economical than that in present use, and the great amount of through traffic on freight lines precludes the possibility of devising any system which differs radically from that at present in use. For instance taking the figures from the records of the Pennsylvania Railroad for 1893, I find that the freight mileage of foreign cars on the lines of the Pennsylvania Road east of Pittsburgh is in round numbers, 370,000,000, while the freight mileage of home cars is 436,000,000 making almost 46% of the total mileage made by foreign cars. It would seem then, impossible to change the present system of freight traffic without disorganizing the service and decreasing the freight revenue of the road. The importance of freight traffic is shown by the fact that the earnings from freight on all the roads in the United States are between two and one-half and three times as great as those from passenger traffic. The New York Central Railroad Company in 1892 received from their freight traffic $26,000,000 and from their passenger traffic, $13,000,000. On the lines of the Pennsylvania Railroad east of Pittsburgh, the freight receipts were $47,000,000, as against $17,000,000, for passenger receipts.

Suppose then, the question comes up before the managers of a road as to whether they are to equip their lines to be operated entirely by electricity. It seems to me as matters now stand, it will not pay trunk lines to change the method of operation for freight traffic, and the question to be considered would be the operating of the lines partly by steam and partly by electricity. Let us consider if it is possible to run the passenger service wholly or partly by electricity. Considering a two track road doing a through as well as a local business I think we can decide that unless the case be an exceptional one, it will not pay to equip the main line electrically. It is necessary that the through express service be continued, and that the freight service be continued, and an attempt to operate the local trains with the through trains could not be successful if there was any considerable amount of through traffic. With a four-track road the condition of affairs is somewhat different. If the road operates between cities acting as terminal points for all passenger traffic, as with some of the

1. Inaugural Presidental Address delivered before the Amer. Inst. of Elec. Engrs., Niagara Falls, June 26-30, 1895.

lines between Boston and New York, then by equipping all four tracks it would be possible to run express service at short intervals on two of the tracks, and on the other two tracks to run freight and local trains. At present it would not pay to use electric locomotives operated from a central station for the freight service, but the local service could be operated electrically, and as the speed of the local trains would be approximately equal to that of the freight, there need be no serious interference with the traffic. We would then have express passenger service working under favorable conditions, that is, with a number of trains evenly distributed; a local service operated under similar favorable conditions and with no interruption to the freight traffic. If the road however is to transport a considerable number of foreign cars, as for example the New York Central or the Pennsylvania Railroad, then the condition of affairs for express service would not be so favorable, and the question of the equipment of the tracks for express service would have to be carefully considered. As far as the branch lines go, whether it would pay to partially or wholly substitute electricity for steam, depends upon the local conditions. A long branch with a small amount of local traffic it would not pay to equip, but on a short branch with considerable passenger traffic and comparatively little freight traffic such equipment would pay. I find that in 1893 the total number of through passengers carried by the New York Central Road was 234,650, while the number of local passengers was 21,978,979. It will be seen that the through traffic is but a small percentage of the total number of passengers, and that the question of preserving the local traffic is of great importance. Now, the greater part of this local traffic will in the next few years be taken by the electric roads paralleling the steam roads unless some effort is made either to control the electric roads or to give an equally good service between adjacent towns. This latter is possible using the ordinary steam tracks only when the distances between towns are small and the amount of freight or through traffic is also small.

There are certain kinds of local traffic which the steam roads must, to a large extent lose, and which in the nature of things they cannot regain. In large cities having a considerable suburban traffic the trolley roads, forming as they do a network of lines within the city and extending in every direction into the suburbs, offer advantages with which the steam roads cannot compete. In Philadelphia one of the large steam lines lost so much traffic that it has attempted to regain it by reducing prices and increasing the number of trains. In this effort it has partly succeeded, but at the cost of greater expense and decreased receipts. To counterbalance this loss at central points railroads may hope by the introduction of electricity, to increase their earnings along the lines and on their branches.

As to the nature of the equipment that will be required it would depend on the work to be done and the branch that is to be equipped. In some cases it might be well to use single electric cars running on the steam tracks between towns and on the local tram lines in the towns. As the speed would be very different in the town and on the railroad line, and as the voltage could also be different, it would be well in this case to use a number of motors on the car, and to use a series parallel controller, the motors being in series for the town traffic. For instance, suppose we wish to run at a maximum speed of forty miles per hour between two towns, and it is economical to use 1000 volts on the line, we could use two motors on the car, run them in parallel on the main line at a speed of forty miles per hour; while in town, with a voltage of 500 we could run them in series at a speed of 10 miles per hour. I can hardly imagine a case where the three-wire system could be economically used for such service on the steam lines.

The condition of affairs in electric transportation is at present, curious. The trolley companies by extending their lines, are working from tramway transportation to through transportation. They are attacking the problem by development from small motors to larger ones. The railroad companies starting with the large units are coming down in the direction of the present trolley systems, as in the case of the Nantasket Beach Road of the N. Y., N. H. and H. Co. Perhaps in the future they will meet and some standard electrical system will be adopted for the present steam road. I think then, that in the case taken up, the policy of the road will be to equip those branches for which the conditions are favorable with a trolley, run comparatively large motor cars capable of drawing one or two ordinary passenger or freight cars as trailers, using the present steam service for their freight traffic when necessary. This will allow the necessary through travel, will give the required local service between towns, and will not interfere with the freight traffic.

As for the systems to be used for such services I believe that at the present moment the continuous current overhead trolley system is the only one that can be selected with a certainty of successful operation. It gives a minimum complication in the way of conveying the current to the cars, it allows a considerable range of speed with a comparatively high efficiency, and our experience with it is such that successful operation could be at once guaranteed. By using different voltages in the towns and on the line, both high and low speeds can be obtained. If the line to be operated is to be very long, it might be best to use rotary transformers at different sub-stations along it, the line being supplied by continuous currents from the sub-stations. In fact the three systems that are at present possible, are first, the ordinary direct current system, second, a system in which direct currents are used on the line and rotary transformers supplied by alternating currents are placed along it, and third, a two or three phase system supplying rotary field motors on the cars. In the latter case, it would be well to employ different periods in the towns and on the lines.

The second case which I wish to consider is that of roads built for an entirely new electrical equipment such for instance as the elevated roads in Chicago, and the underground rapid transit road in New York, or the proposed Washington-Baltimore Boulevard line. In most of these cases, the traffic is almost entirely a passenger traffic, and the conditions are especially favorable for the operation of electricity. Taking first the case of the New York underground road, there will probably be required about 150 trains for local service, each train having five ordinary cars and a motor car. For the express services there would be about 25 trains, of say, four ordinary cars with a motor car. For this, it would probably be best to use the direct current three wire system, one of the cars on the train being equipped with motors and acting as a locomotive. With four motors on a car the system would be efficient at all practical speeds, and, if desired, a large part of the energy could be thrown back on the line when the cars are being stopped. In the case of the local trains a simple calculation will show that a very small part of the total energy expended is used in overcoming the track resistance, while a very considerable part is employed in accelerating the train and afterward wasted by braking. I have calculated the amount of energy which can be practically saved under the conditions of local and express traffic on the New York underground road and find that with motors of ordinary efficiency about 45% can be returned. If storage batteries are used in connection with the central stations, the batteries being located along the line, a uniform load can be thrown on the stations, and their capacity may be reduced to almost one-half as compared with a system in which the energy is not returned; thus greatly decreasing both the expense of installation and of operation. As it is possible at present to obtain batteries with a rapid discharge rate at very reasonable prices and with a guarantee for repairs that places them well within the limit of commercial calculations, a system of this kind offers some advantages over any other system that could be applied to the operation of the underground road. An alternating current would hardly be economical for this work, as it precludes the possibility of returning the energy to the line, and as the variable speed required makes it uneconomical as compared with the direct current system using, say, four motors with series parallel control. In the case above cited, shunt motors would be used, and it would be possible to get a contact with the line that could not under any circumstances be broken. The case of the elevated roads is very similar to the one I have cited except that in existing structures shorter trains would be used, and the cost of equipment for a given number of cars would be somewhat greater.

Baltimore has been the pioneer in almost every branch of transportation. In ocean service, the record of the Baltimore clipper is a tradition of our maritime supremacy. The Baltimore and Ohio Railroad was the pioneer steam road. An electric road from Baltimore to Hampden built in 1885 gives us a right to boast of our pioneer work in electrical tramways. The immense locomotive for the Baltimore Belt Line Tunnel is the first instance of the direct displacement of steam by electricity, and the line over which it is to be operated is the first through steam line to be equipped electrically. The Baltimore and Columbia Railway Co. owns in Washington the Eckington and Soldiers' Home Railroad and the Belt Line Railroads, and has franchises for extensive additions to their present mileage. In Baltimore they are constructing a road in the city and beyond it to Ellicott City, and they have also purchased a steam line running from Baltimore to Catonsville. They have rights of way from the terminus of their Baltimore lines to the lines they own and are preparing to build in the District of Columbia. The problem offered is not a simple one, but it is one of the most attractive that can be presented to electrical engineers. Speeds of 60 miles per hour are to be used for the cars outside of the city limits, and within the city limits ordinary speed is to be employed. In the District of Columbia overhead trolley lines are not allowed, and some type of conduit will have to be employed. In fact there is presented almost every problem which must be solved if electricity is to displace steam in the future with the same rapidity that it has done in the past. Many high speed electric roads have been projected; a number of them occupying considerable space in the newspapers; but I think this road will be the first to solve the detailed problem of interurban rapid transit.

The last subject which I wish to take up is the electric plant for the Belt Line Tunnel of the Baltimore & Ohio Railroad. In this case there is no question of economy in the employment of the electrical locomotives, as the plant adds considerably to the

cost of operating the road. The Belt Line Tunnel runs beneath the city of Baltimore for a distance of one and one-quarter miles, then to the outskirts of town through open cuts and short tunnels. There is a grade of .8 of one per cent. over almost the entire length of the tunnel proper, while one-half mile beyond it there is a grade of 1½ per cent. Being in the middle of town it would have been difficult to have provided a satisfactory ventilating plant even supposing that ventilating plants had been successful in other localities, which is not the case. The managers of the B. & O. Railroad Co. wished to provide a satisfactory service, and considered a number of plans for drawing their trains through the tunnel without the annoyance due to smoke and gases. After careful consideration they concluded that electricity was the most satisfactory means to accomplish this, and the General Electric Co. was confident enough of its ability to successfully equip the road to make a contract with the B. & O. Co. to haul its trains over the Belt Line, the contract being dependent upon the successful operation of the plant. The total length of the line equipped is about three miles, the extension beyond the tunnel being for the purpose of assisting the freight locomotives to haul their trains up the 1½ per cent. grade on the line beyond the tunnel. There are to be three locomotives and it is calculated that the traffic can ordinarily be handled by two of them. The steam engines are not to be taken off the train, but hauled through the tunnel by the electric locomotive which switches off at the terminus of the line. To operate these machines, a station has been erected which contains 3,000 H. P. of electric generators, and an overhead line has been equipped to transmit the current to the locomotives. With respect to the station itself, there is little that is novel. There are four 750 H. P. Allis-Corliss engines directly coupled to generators of the same capacity, the generators having a voltage of 600 at no load and 700 at full load. The foundations have been partly erected for a fifth unit in case it is found necessary. The building also contains a lighting plant having a capacity for 400 arc lights and 4,000 16 C. P. incandescent lights. Provision has also been made for an extension to this lighting plant when the stations for the Belt Line are erected. There are two incandescent machines and one of them will be used to supply the 1,000 32 C. P. lamps which have been installed in the tunnel. Perhaps the most novel feature of the plant is the overhead structure that is employed. The conditions to be met were peculiarly difficult, and the ordinary underrunning trolley was considered impracticable. The tunnel is very low in places and the management of the road decided that the conductors could not be placed over the cars, but should be placed in the middle of the tunnel between the tracks. Outside of the tunnel the conductor is still between the tracks, but is elevated to a height of 22 feet, while inside of the tunnel it is only 17 feet from the top of the rail. The conductor consists of an iron trough made of two Z bars riveted to a cover plate 12 inches wide, leaving a slot one inch wide between the Z bars. In the tunnel this trough is supported from transverse channel bars secured to expansion bolts which are fastened in the top of the tunnel. There is a double insulation; one porcelain insulator being between the trough and the channel bars, and another between the channel bars and the expansion bolt. Outside the tunnel the trough is supported as follows: At distances of 150 feet light iron columns with cross trusses are erected, and between these trusses are hung catenaries supplied with a number of suspension bolts. Transverse channels similar to those used in the tunnel are fastened to these bolts, and the trough is fastened to the channels. The Z bars are made in lengths of 30 feet the opposite bars breaking joints with one another, the lengths being riveted together and then bonded with "Chicago" rail bonds. Suspended on the same transverse beams as the trough are three copper cables of 1,000,000 C. M. area which serve as feed wires and which are connected at intervals with the trough, there being of course one trough for each track. For the return circuit the tracks are bonded as in ordinary railroad work, there being cross bonds and at intervals connections with a copper cable of 1,000,000 C. M. area carried in a wooden trough between the tracks. The contact arrangement that it is to be used consists of a brass shoe travelling in the trough and connected with the locomotive by a flexible saw buck arrangement which has a very considerable range in every direction. The current is transmitted to the motors by a copper cable, and in case of the shoe sticking in the trough, a safety pin is arranged to break with any desired strain. Where switches are used there is a tongue worked by the lever which operates the track switch, and which serves to direct the shoe. This structure, although exceedingly massive and expensive promises to give an excellent contact at all times, and it requires no care from the motorman.

The locomotives are the most massive in the history of either steam or electrical transportation, and the weight, which amounts to 95 tons, is on eight driving wheels so that the full tractive power of the locomotive will be developed. On each axle there is sleeved a 6-pole motor, there being considerable play between the axle and the sleeve which latter is spring-supported from the frame. In this way any heavy blow due to irregularities in the track is taken through the springs, and the wear both of the track and the locomotive is reduced. On the armature shaft are projecting arms which move between lugs cast on the wheels, thus allowing the necessary relative motion between the axle and armature.

The situation in the Baltimore Belt Line plant is this: The station is completed and is being operated daily. One of the locomotives is on the ground set up and ready to run, and the overhead work is finished with the exception of a short length which was interfered with by a temporary bridge over a cut. The latter has been removed and the plant should be ready to run this week.

If this equipment proves successful it will open a limited but important field for the introduction of large electric locomotives. There are in the United States a number of tunnels whose operation is anything but satisfactory at present, which can be equipped as the Baltimore Tunnel is equipped. Several of them have the additional advantage that they are near the switching yards of the roads and the same plant could be used for hauling trains through the tunnels and for switching, and not only would the economy of the station be increased, but the substitution of electric for steam switching engines would result in a very considerable saving.

This is the last of the subjects that I proposed to consider. In this paper I have not indulged in prophesy nor have I imagined any apparatus or equipment which cannot be bought to-day in the open market. But to me it seems that the present is a crisis in the history of railroading. Up to the present the steam roads have ignored the competition of electric roads or they have fought them. To-day they cannot afford to do either. In a few years electric roads will have absorbed practically all of the local traffic and will begin to cut into through transportation. The steam roads cannot afford this and their only safety is to make of electricity an ally instead of an enemy, and this before it is too late.

The conclusions that I finally reach are these:

1st. The tendency of passenger transportation on the steam lines has been in the direction of the greatest electrical economy while the tendency of the freight transportation has been in the direction of the least electrical economy.

2nd. It will not pay any through line with considerable traffic, having two tracks, to equip their main tracks electrically.

3rd. With four track roads it will pay to equip all of the tracks electrically unless a considerable portion of the business is through passenger traffic.

4th. It will pay all the larger roads either to equip a number of their branch lines electrically, or to control competing electric lines.

5th. In order to remain on a dividend paying basis it is imperative that most of the two track lines either build additional tracks or control the electric railroads that parallel them.

6th. Believing that ultimately all of the traffic will be done by electricity, it is imperative that the managers of steam roads keep constantly in touch with electrical progress.

REORGANIZATION OF THE LONG ISLAND TRACTION SYSTEM.

Clinton L. Rossiter, assistant superintendent of the western division of the New York Central Railroad, has accepted the Presidency of the Brooklyn Heights Railroad, and took Mr. Lewis's place on July 1. These are the plans for the reorganization of the Long Island Traction Company, which holds the lease of the Brooklyn Heights road: The formation of a new company, which will assume the lease, assets, and liabilities of the old company; the formation of a new company with $20,000,000 common stock, to be exchanged for Long Island Traction stock on certain conditions; the issue of $6,000,000 of bonds to run ten years, and pay 6 per cent. interest; the levying of a 10 per cent. assessment on the stock of the Long Island Traction Company; the collateral notes to the amount of $1,800,000, which are mainly held by the Flower syndicate, to be taken up on Aug, 6, when the one year's option will expire; the guaranteeing by an underwriting syndicate to the new company the full payment of the assessment and full subscriptions to the stock.

A DENVER CAR.

One of our correspondents reports riding recently on a car at Denver, Col., which is making 280 miles a day, turns 16 right angled curves every 20 minutes, and has been on the line for months without repairs.

BOSTON WEST END EARNINGS.

West End Street Railway earnings for Saturday, Sunday and Monday June 15, 16 and 17 surpassed the record of any previous three consecutive days in the history of the company, and the earnings for June 17 exceeded the earnings of Memorial day, which were the largest in the history of the company. The earnings for the three days averaged $26,800, and were in detail as follows: Saturday, June 15, $28,400; Sunday, June 16, $22,100; Monday, June 17, $30,000.

THE GENERAL ELECTRIC CONDUIT SYSTEM ON THE LENOX AVE. LINE, NEW YORK.

FIG 3. *The Plough.*

The first practical electrical underground conduit railway in this country is now in operation and will this week be connected to the great cable system of the Metropolitan Traction Co. The public will then be able to travel from the Battery to 146th Street, with one transfer, from the cable car to the electric car, at W. 108th Street.

The Lenox Avenue line is a double track road, starting at the car house at 146th Street and running directly south to 116th Street, into which it turns and proceeds as far west as Manhattan Avenue. It turns there and runs as far south as 108th Street, along which it is carried to the junction of that street and Columbus Avenue. The power house is a temporary frame structure with a sheathing of corrugated sheet iron, located on 146th Street a few yards west of Lenox Avenue. The present power plant consists of two 650 H. P. engines and 400 K. W. generators. Steam is supplied from 2 Babcock and Wilcox water tube boilers, arranged in one battery. Each has a rated capacity of 250 H. P. furnishing steam at 120 pounds. The engines are horizontal cross-compound Allis-Corliss machines, which during the experimental trips are run non-condensing. All the steam piping is placed beneath the floor of the engine room. To each of the engines is coupled a General Electric 400 K. W. generator of standard construction but wound for 350 volts, instead of 500 volts as is the usual practice in railway work. This machine is placed between the high and low pressure sides of the engines.

From the generators the cables run beneath the switchboard to a subway, under the sidewalk on 146th Street extending as far as Lenox Avenue, where they are introduced into the five-inch iron pipes running parallel with the conduit. For the present the line will be operated directly from the power house, but the feed wires will probably be placed in the pipes and will be tapped into the conductor at the necessary points. This line will then be divided up into sections and its general operation thereby greatly facilitated.

The construction of the underground contact system is simplicity itself. The plough suspended from the car truck passes through the slot in the centre of the track and presses against the flat surfaces of two iron conductors running the entire length of the conduit. These conductors are placed each three inches on each side away from the centre of the slot, to avoid deleterious effects of any drip which would otherwise reach them, and are of channel iron four inches deep and thirty feet long. They are suspended from the ceiling of the conduit by means of insulators devised for this especial purpose, and are at a depth of thirteen inches below the conduit slot. Each conductor is sufficiently rigid to require suspension at the ends and

F. S. Pearson.

L. J. Hirt,

centres only, and the ends being located in the manholes and hand holes being placed at the centres, inspection and repairs are rendered comparatively easy. The conductors are bonded to each other by stranded copper wire securely riveted into the web of the metal.

Another form of suspension of the conductors was also tried for a length of about one hundred yards single track on 116th Street, between Lenox and Seventh Avenues. This is known as the pedestal method of support. At the manholes instead of insulators suspended from the ceiling of the conduit, the conductors are supported by a soapstone pillar. The channel bar conductors in this case are five inches deep and are set 12 inches below the slot. The soapstone pillars are provided with iron caps furnished with brackets to which the conductors are bolted, and continuous connection is secured by means of a bond of flat copper strips riveted to the webs. The soapstone blocks are set in iron bases erected in the manholes. It is understood that no more pedestals will be used.

Every twelfth manhole is connected with the power house by

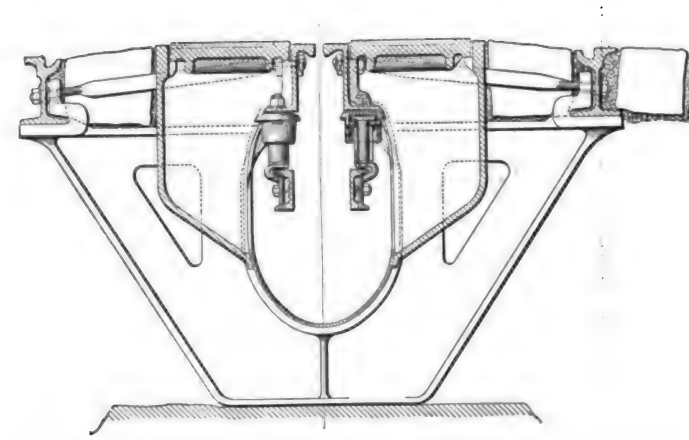


FIG. 1.—NEW YORK ELECTRICAL UNDERGROUND CONDUIT SYSTEM. SECTION OF CONDUIT—INSULATOR SUSPENSION.

telephone. Quick break switches are located at intervals in these manholes, in order that any section of the line may be cut out in case of trouble or accident. At the track switches each conductor is provided with a flaring nose to facilitate the entrance of the plough into the conductors. The manholes in which the insulators are placed are 4 feet 4 inches in depth, 4 feet in length and 14 feet 5½ inches in width, that is, the entire distance of the two tracks. They are constructed of brick with 8 inch walls that rest on concrete foundations. The floors are laid with 6 inches of concrete and are provided with drains for carrying off

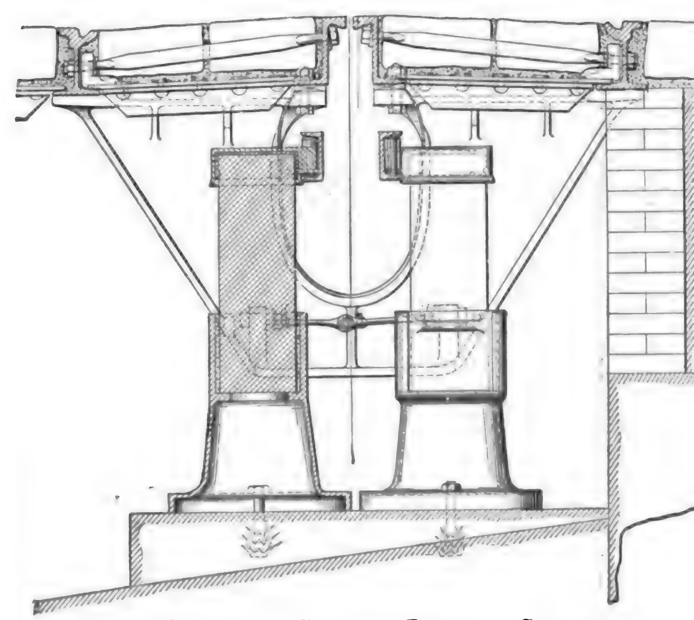


FIG. 2.—SECTION OF CONDUIT—PEDESTAL SUPPORT.

water. With this provision for drainage no trouble from water in the conduit will, it is believed, be experienced. The conduit was built along the grade of the street but with sufficient pitch to permit any water flowing into the conduit to find its way into the manholes, located every 30 feet, and from thence into the sewers.

The current does not return by means of the rails. Each conductor forms one side of the working circuit. The current merely rises on one side of the plough, passes through the controllers into the motors and after performing its duty returns by the other side to the opposite or negative conductor.

The plough or traveling contact arrangement is also essentially

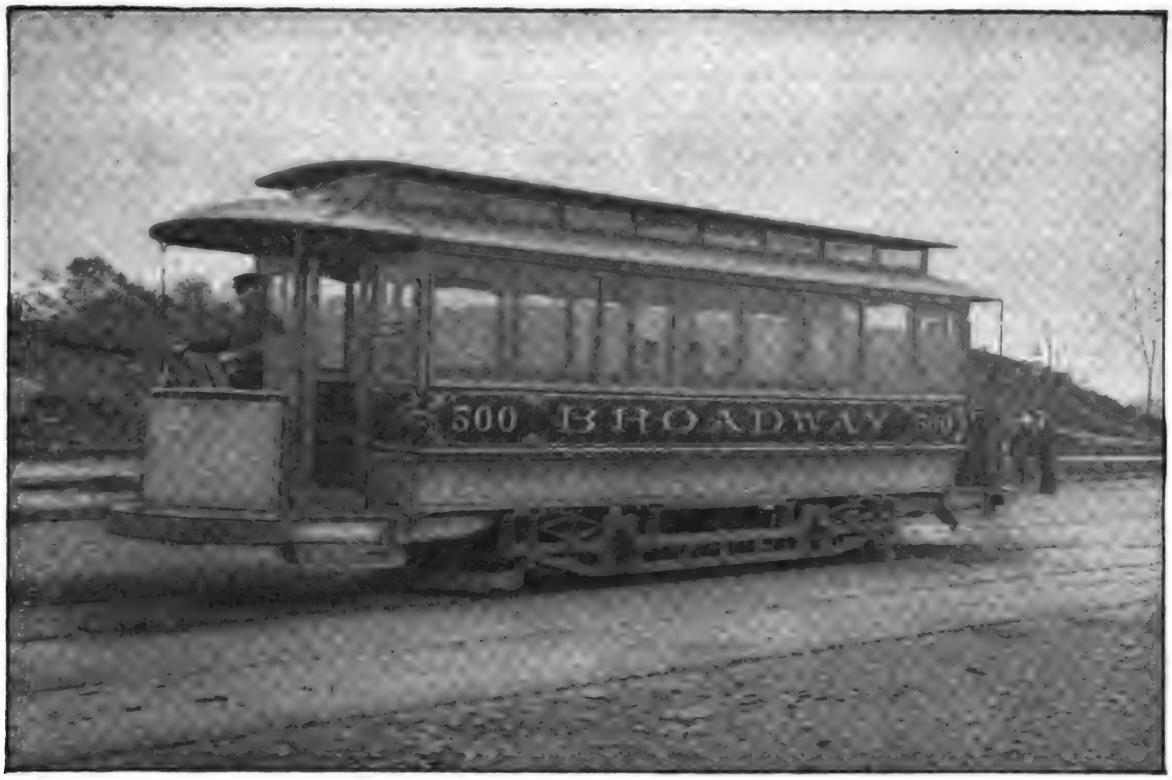


FIG. 4.—NEW YORK ELECTRICAL UNDERGROUND CONDUIT SYSTEM. THE CAR AND THE TRACK.

novel. It consists of two pieces of iron, one on each side of the plough, supported on spring leaves which cause them to press outwardly against the two conductors. The plough is suspended from a longitudinal bar bolted to cross beams set upon the track and is constructed of two sheets of steel laid each one upon a plate of fibre. The two sheets of fibre are then brought together enclosing strip copper conductors connected at the top to the motor cables, and at the bottom riveted to two other pieces of sheet steel. These run on each side of the plough and serve as supports for the hinges which carry the sliding contact pieces. A heavy sheet of fibre continues downward and serves to separate these contacts.

The motors employed are the standard General Electric 800 machines, handled by "K²" controllers. The cars which are used on the line were constructed by the John Stephenson Company and are mounted on standard cable trucks constructed by the Peckham Motor Truck and Wheel Co. They resemble those used on the Broadway line. The cars are lighted by nine incandescent lamps arranged in groups of three each. A car barn similar in construction to the power house has been built at the

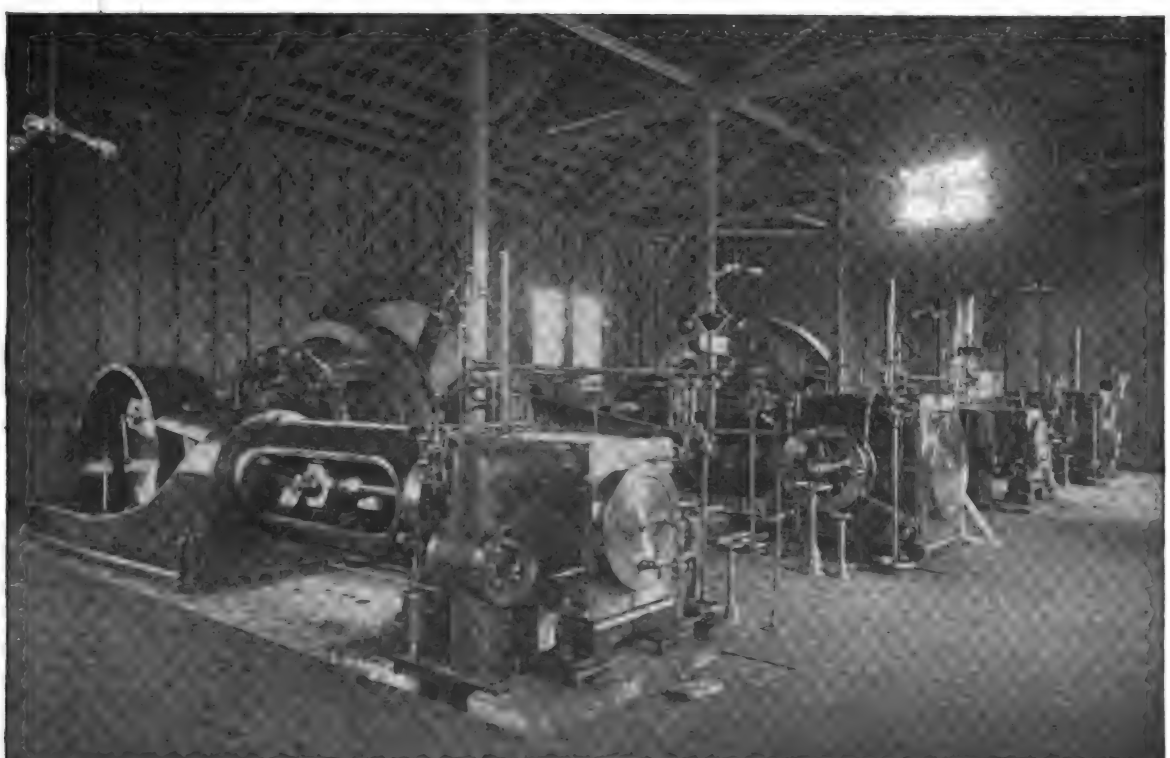


FIG. 5.—NEW YORK ELECTRICAL UNDERGROUND CONDUIT SYSTEM. INTERIOR OF POWER HOUSE.

corner of 146th street and Lenox avenue. The building is provided with four tracks and has a storage capacity for about twenty cars. The tracks are provided with pits for the examination of the trolleys and motors.

It is stated that in case the operation of the electric conduit system proves successful, the power will be increased by the addition of three direct connected units of 1,500 H. P. each, making the total capacity of the station 5,000 H. P. The present temporary structure will be replaced by a handsome brick building for a power plant, car house and repair shops. It will be built on the west side of Lenox Avenue, on which it will extend 200 feet, and its depth will be 550 feet. It will be two stories in height, constructed of a steel skeleton inclosing brick walls and will be fireproof. The car house will have a capacity for about 350 cars. The office of the receivers and starters, as well as the waiting room for conductors and motormen, will be located at the corner of 146th Street. The car house will be provided with two large elevators, which will be operated by electricity. Ample provision has been made on the ground floor for repair shops and rooms for the engineers and firemen. The superintendent's office and a large reading room for the employés will be arranged on the second floor. In the tower on the third floor accommodations will be provided for the electricians of the station.

THE ELECTRICAL EQUIPMENT OF THE NANTASKET BEACH ROAD.

The first direct application of electricity to the steam railroad has been made on the Nantasket Beach branch of the New York, New Haven and Hartford Railroad, and the first runs as already described in THE ELECTRICAL ENGINEER have proved remarkably successful. The line was almost exclusively operated by the electric trains on the 30th of June. The Nantasket Beach railroad extends from the Old Colony House Station, Boston, as far as the Pemberton Station, a little beyond Hull, at the extremity of the narrow Peninsula, one side of which is known as Nantasket Beach. The length of the road is 6.91 miles and of this there are 4.4 miles of curves in about 20 curves, the sharpest being one of 10 degrees. The line is almost level, the only grade, one of about 34 feet to the mile, occurring within the first mile out from the Old Colony House Station, the name of which has been recently changed to Nantasket Beach Junction. The track is laid in 70 pound rails, with 15 feet space between the track centres, and the ballast is of stone. Each joint is bonded with a flexible No. 0000 bond of stranded copper, seven inches long, riveted into the flange of the rail. The line traverses two trestles and one plate girder bridge, the latter located near the Stony Beach Station. Engineering difficulties were, of course, met with. Six thousand yards of rock ledge were taken out near the Old Colony House Station, and between Stony Beach and the terminal station at Pemberton a heavy retaining stone wall had to be built on the shore side of the track. On the sea side of the track, a second retaining stone wall, about three-quarters of a mile long and varying in height from eight to fifteen feet, and in thickness from ten to fifteen feet, has been constructed to take the place of a trestle.

There are at present ten stations on the line, but other stations will be built to allow of stops at about every quarter of a mile. At Pemberton, the station consists of two 500 feet roofed platforms between the tracks, and a similar length of platform outside the tracks.

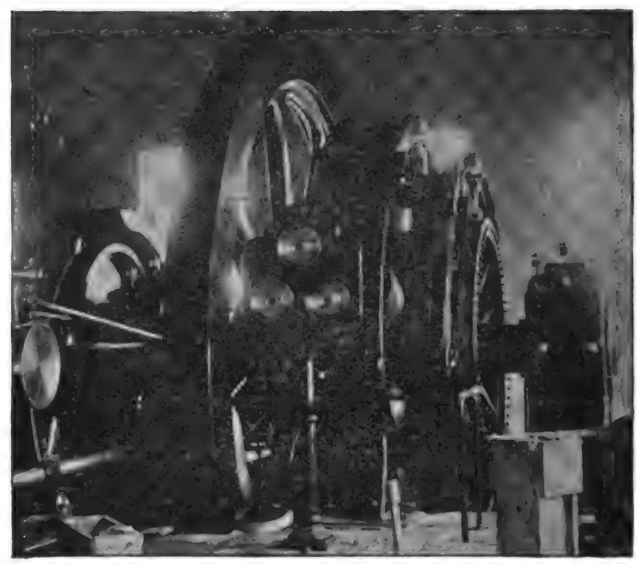
The overhead trolley line is carried upon poles set between the tracks. These poles are of southern pine, thirty feet long, twelve inches by fourteen inches at the butt, and ten inches by ten inches at the head; and are set at intervals of sixty and seventy feet on the curves and ninety feet on the straight track. At the cross overs the posts are 180 feet apart, and side posts are used carrying a light iron truss over the track. On the trestles they are carried down through the trestle floors and are bolted to cross timbers fastened to the piles. The top of each pole is fitted with a cast-iron grooved cap, the grooves of which carry the six bare copper feeder cables, each of which has a cross section of 500,000 circular mils and weighs 1.56 pounds to the foot; each consists of 49 No. 10 gauge wires being laid in seven wires of seven strands each. The poles are set in wooden boxes filled with concrete, and are set towards the inside track on curves to throw the trolley wire over, and thus provide for the angle of the trolley pole caused by the 4.8 inches elevation of the outer rail.

The trolley wire is of pear shape in cross section. It weighs one pound per foot and has a cross sectional area of 330,000 circular mils. The lower surface is almost flat, and provides a large contact surface for the trolley wheel. This form has been given to the wire to permit of a more perfect attachment to the hangers and to prevent the trolley from jumping when passing them.

The brackets, of two angle irons, are bolted across the centre poles and bent and bolted together at the ends. They are kept in position by an iron truss running through the cap. Each hanger is a double hanger and gives an excellent support for the wire. In stringing the trolley wires and setting the poles, steam locomotives were employed, and by their use the work of months was shortened into weeks. Indeed, the entire installation is an example of extremely rapid work.

The power house, which will be known in history as "Power Station No. 1," of the New York, New Haven & Hartford Railroad, is located 5,900 feet from the junction station. It is a brick station with stone trimming erected on a rock foundation, and has a slate roof on steel roof trusses. It is 79 feet by 100 feet inside the walls and is divided by a 24-inch brick partition into engine room and boiler room, each 79 feet by 52 feet. The power house proper is provided with a travelling crane of 53 feet span, the dividing walls being reduced in thickness to accommodate this length of span. The boiler room is equipped with two batteries of 4 boilers each. The boilers are of the horizontal type and are 72 inches in diameter, 19 feet long, with 140 three inch tubes. Each boiler has a nominal rating of 185 H. P. but will generate 350 H. P. at 125 pounds steam pressure. The flues enter a 115-foot circular brick stack, 13 feet in diameter at the base. This stack was put up in 11 days and 6 hours.

The engines are two in number, and are horizontal tandem compound Greene engines erected by the Providence (R. I.) Steam Engine Company. The shafts are 18 inches in diameter and carry fly wheels 18 feet in diameter, each weighing 32 tons.



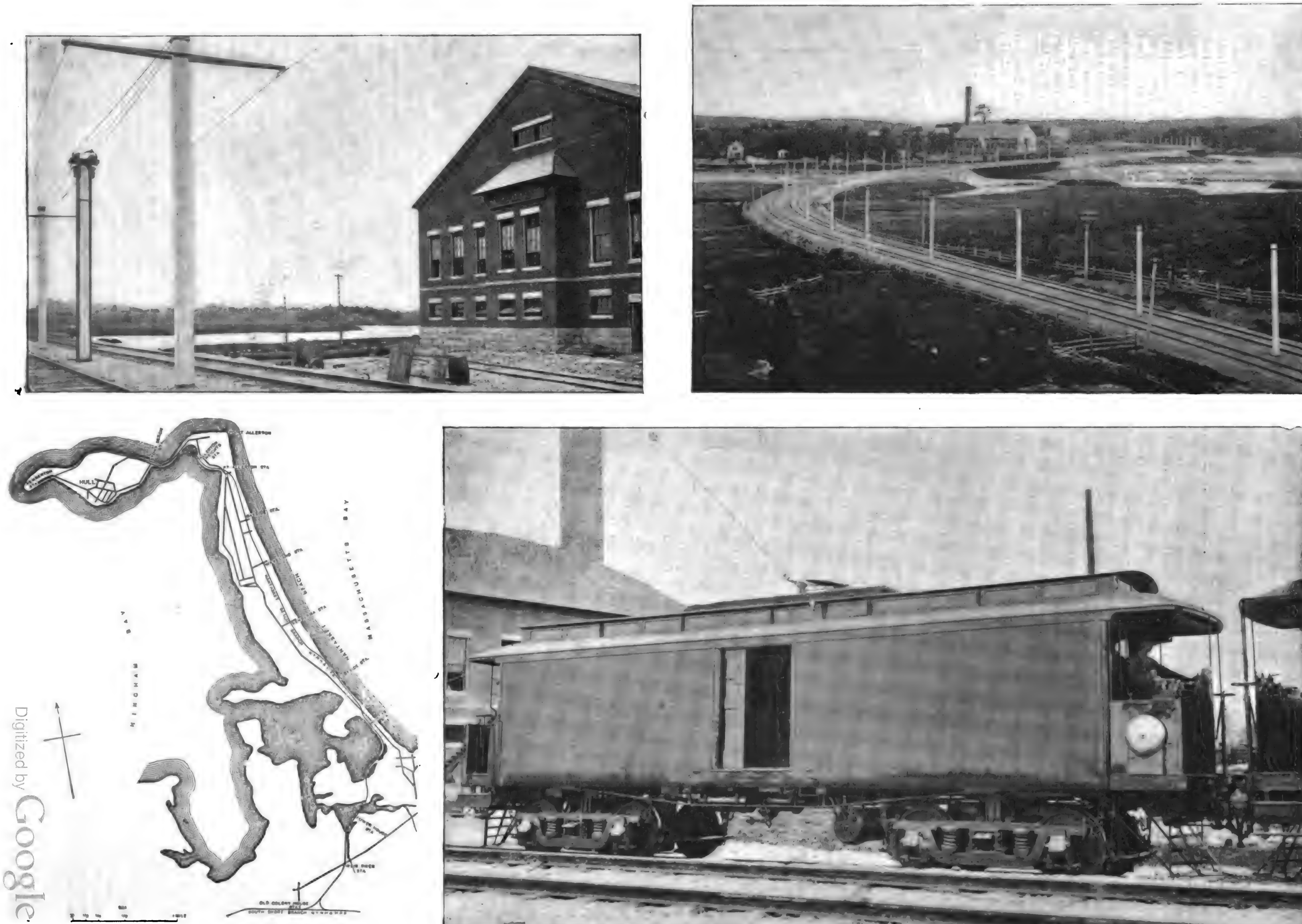
INTERIOR OF POWER HOUSE SHOWING GENERATOR, NANTASKET BEACH ROAD.

The engines can be operated non-condensing or condensing, and are furnished with automatic safety stops and steam closing mechanism.

The generators are direct connected General Electric 10 pole machines having the armature spider keyed to the engine shafts. They are wound for a pressure of 600 volts at no load and 700 volts at full load, and are rated at 500 kilowatts at 100 revolutions per minute. The fields are of cast steel and the armatures are of the "Iron Clad" type, each winding being insulated and then imbedded in an insulated slot in the laminated iron armature body. The ten brushes are all operated simultaneously by a hand-wheel, and are arranged to secure the most perfect contact with the commutator.

The switchboard is placed in front of the engines, and is built up of two standard G. E. generator panels, set one upon each side of a third panel, carrying a form "G" recording watt-meter, showing the entire out-put of the station. Each generator panel carries a "K" automatic circuit breaker and the usual indicating and measuring instruments and switches for the power as well as the lighting circuits. From the switchboard the current passes along a lead covered cable, set in a 3½ inch drain pipe in concrete to a junction box at the foot of the nearest pole, up which it is carried in an iron pipe to the longitudinal feeder.

The motor cars are of two types—the closed and the open. The closed cars are heavy baggage cars, and four are already equipped for service. The open cars are sixteen reversible bench cars, and six are now receiving their equipment. The open cars resemble the familiar city trolley car, but have a flight of three continuous steps or foot boards. The closed motor cars are 42 feet long over all, and are built extra heavy, weighing each, when fully equipped, over 30 tons. Two of the four ordered will have two motors on one truck, while



Nantasket Beach Railroad; *Showing Map of Road, Power House, Line and Car.*

the two others will have four motors, two on each of the two trucks. The open motor cars will be two motor cars. The motors used are the "General Electric 2,000" machines especially designed for heavy work, and are similar to those in successful use on the Metropolitan Elevated Railway in Chicago. They are watertight and fireproof. The drawbar pull of the two-motor motor cars is 4,000 pounds; that of the four-motor motor cars 8,000 pounds, the motors being 100 H. P. each, or 2,000 pounds horizontal drawbar pull through a 33-inch wheel. The current is brought to the motors from the trolley wires by means of a trolley provided with a wheel having an extra deep channel, through a General Electric series parallel controller, set up on the right hand side of the platform. This controller is known as type "L" and is somewhat larger than the "K²." It embraces the magnetic blow-out principle and all the other familiar features of the "K²." The resistances are suspended beneath the car. Two controllers go to each car.

Immediately to the left of the controller is the air brake handle. The compressed air for the brakes and whistle is furnished by an oscillating cylinder air compressor operated by an electric motor, which is controlled by a special automatic rheostat which regulates the action of the motor in accordance with the pressure in the tanks. A magnetic cut-out is also provided for the air compressor motor. In the case of the closed cars the air pump is set just within the door; in the open cars it stands on the platform to the extreme left of the motorman.

Behind the motor man and just under the hood is the car cut-out, which in this case is an automatic circuit breaker similar in type to that used on the generator panels in the station. Two fifteen inch gongs are furnished to each car and are rung by the foot, and on one side near the centre of the car on the roof is a chime whistle operated by compressed air. The open cars are lighted by eighteen incandescent lamps, and the baggage cars by six. Each motor has a small pilot or cow-catcher placed beneath the platform. A feature of the line construction is the system of interlocking switches by means of which the overhead switch is thrown at the same time as the track switch.

The trains will be run as accommodation or express, the express trains consisting of a baggage motor car with open trailers, the accommodation facilities being furnished by single motor cars. The traction weight of the baggage cars will be increased by the baggage they will carry, and the light trains should be operated without difficulty. At Pemberton station the cars will run with the baggage car at the head. The motor car will then uncouple, switch and run back to the head of the train, the motorman changing platforms.

Credit is not only due to the New York, New Haven & Hartford people for their courage in essaying the new method but also to the men who have developed the machinery to enable them to carry it to a successful conclusion. Everything has been done upon the personal initiative of the President of the road, Mr. Chas. P. Clark. The electrical installation was effected on the plans laid out by Col. N. H. Heft, who personally supervised the work.

The tests made on this line are of considerable interest. The first showed that the motor car alone or with a small load could run at a higher speed than that attained by ordinary express locomotives, and maintain the speed without difficulty, and this without apparent effort. Subsequent tests were made with the locomotive or motor car as a freight hauler and not less than fifteen heavily loaded freight cars were easily moved and carried along the line at a high rate of speed. So far everything was satisfactory.

The crucial test was made on the 27th June when under Division Superintendent J. C. Sanborn's care a select company comprising nearly all the division superintendents and engineers of the New York, New Haven and Hartford R. R. and a few newspaper men were taken over the line. A special train of two passenger cars was made up and hauled as far as Nantasket Beach Junction, by a steam locomotive, which was uncoupled at this point and its place taken by one of the two-motor motor baggage cars. The coupling was effected without shock, and the train moved off in the direction of the power house without jerking on the couplings and considerably more smoothly than would have been the case with a steam engine. At the Power House, the company were shown everything by Col. Heft, and evinced great interest. By this time Mr. J. C. Sanborn's surprise was ready. A call brought the guests to the windows of the power house, in time to see a long train consisting of a motor car, about thirty gravel cars, fully loaded, and a brakemen's van, go flying by at 40 miles an hour in the direction of Nantasket Beach. After the inspection of the Power Station, the company reembarked and Col. Heft stationed himself at the controller. The gong clanged, and the whistle shrieked, and in a few moments the train of three cars swept at 40 miles an hour in a blinding rain storm towards Pemberton Station. On the return journey Col. Heft threw over the handle of the controller when the train came to the straight stretches, and the motors responded in a quiet effective way, sending the train whirling along down the wet track at a speed of over 50 miles an hour. The line was opened for regular passenger traffic with the electric car last Sunday.

TELEPHONY.

THE PITTSBURGH MEETING OF THE INDEPENDENT TELEPHONE MANUFACTURERS.

In accordance with the announcements issued, the telephone manufacturers in opposition to the American Bell Telephone Company, held their meeting at Pittsburgh on June 24, at the Hotel Duquesne. The main purpose of the convention was to perfect the organization that was formed in Chicago several weeks ago. Plans for the operation of the independent manufacturers were formulated in secret session, and an arrangement to more closely combine the interests of all was entered into. The independent manufacturers at the convention represented a capitalization of about $30,000,000. James E. Keelyn, president of the Western Telephone Construction Company, and also president of the organization, was present as the principal and active promoter of the organization.

The other independent manufacturers present were P. C. Burns, of the American Electric Telephone Company, of Kokomo, Ind.; Stanley S. Stout, of Chicago, attorney for the association; William Dillon, of the Indianapolis Electric Company, of Indianapolis, Ind.; H. T. Johnson, of the Manhattan Electrical Supply Company, New York; A. F. Stanley, of Stanley & Patterson, telephone manufacturers, of New York; A. H. Chadbourne, general manager of the United States Telephone Construction Company, of Philadelphia; Charles E. Blake, of the National Telephone Manufacturing Company, of Boston; W. H. Yerkes, Washington; E. S. Wallace, Columbia Telephone Company, New York; L. L. Levy, Anthony Telephone Company, Cincinnati; J. R. Johnson, Viaduct Mfg. Company, Baltimore; F. Harrington, Union Electric Company, Cleveland; J. G. Ihmsen, Keystone Telephone Company, Pittsburgh. It is understood that about 40 manufacturers have given their adhesion to this movement. The name of the Telephone Protective Association of America will be maintained, and all independent telephone interests are invited to coöperate. It is proposed to organize State associations on the lines of that in Ohio, and to insist on long distance rights over the Bell lines under the common carrier laws.

The Association has completed its organization as follows:—President, J. E. Keelyn, Chicago; First Vice-president, J. R Johnson, Baltimore; Second Vice-president, S. J. Turnbridge, Utica; Third Vice-president, Judge E. S. Wallace, New York; Fourth Vice-president, J. G. Ihmsen, Pittsburg; Fifth Vice-president, L. L. Levy, Cincinnati; Secretary, Paul Bossart, Minneapolis; Treasurer, P. C. Burns, Kokomo, Ind. The Board of Directors is composed of the Executive Committee: J. E. Keelyn, J. R. Johnson and S. J. Turnbridge.

Among the Directors elected are Messrs. E. B. Seeley, of E. B. Seeley & Co., and M. Kuhn, of the Clamond Telephone Co., Philadelphia.

The delegates were entertained while in Pittsburgh by the Solar Carbon & Mfg. Co. of Pittsburgh, which company was represented by Mr. F. Laughlin and son, who gave them a pleasant drive around the suburbs, including an inspection of the beautiful Carnegie Library. While the attendance was smaller than had been hoped for, the feeling was hopeful, and there were many indications of activity.

It is stated that the opposition companies have already about 100,000 instruments installed throughout the country.

NEW YORK TELEPHONE DESK CONNECTION.

The Metropolitan Telephone & Telegraph Co., 18 Cortlandt street, is now offering to give private line telephone service for $100 per year. It is also offering a nickel plated desk telephone, on the line with the main station, at $36 for a flat rate exchange station; $24 for a message rate station, and $24 for a private line station. The company claims to have over 2500 subscribers now on the message rate plan.

TELEPHONE TRAIN DISPATCHING.

Mr. J. C. Henry, who is now living in Colorado, writes us: "While in Denver recently I examined the telephone train dispatching system in use by the tramway company. The dispatcher keeps a train sheet and receives reports from the conductors at the terminals of the different routes. I overheard him, for instance, give the following instructions: 'Hurry up; you are fifteen seconds late, stop at —— for mail.' I am an old train dispatcher, having spent years in worrying with trains that were hours and sometimes days late, and these orders by telephone made me feel like a fossil aroused in the Bellamy ages."

DUBUQUE, IA.—The city council has issued its order that the Bell Telephone Company shall permit the Star Electric Company to use the poles of the former on Highland place.

NEW "M. & B." TELEPHONIC APPARATUS FOR EXCHANGE WORK.

An interesting exhibition of the M. & B. Telephone was given in Rooms 450 and 451 of the Bullitt Building, Philadelphia, on Wednesday, June 26th. The United States Telephone Construction Co. who control the sale of the M. & B. Telephone, and whose offices are in the Bullitt Building have had so many applications for exchange plants, and so many people were desirous of seeing their telephones in operation, that they fitted up a suite of offices in which they have a full line of their various types of telephones displayed, and connections made to several outside points. In conjunction with them the Gould-Smith switchboard was displayed, which is manufactured by the Eastern Electrical Manufacturing Co. The United States Telephone Construction Co. claim to have the only non-infringing battery transmitter. It has

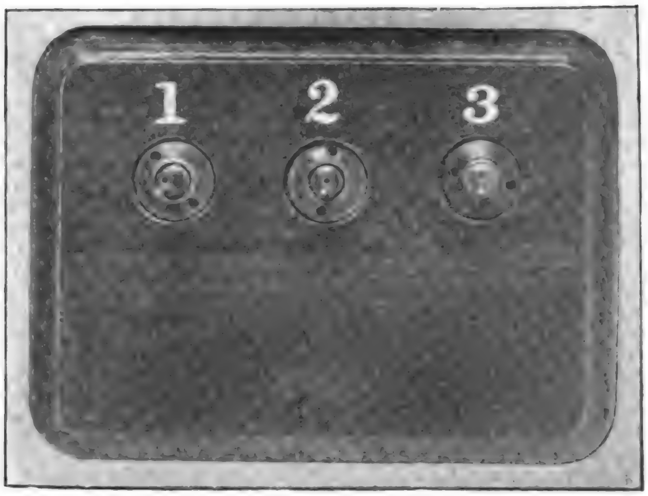


FIG. 1.—GOULD SMITH TELEPHONE SWITCH BOARD.

been described before in previous issues of THE ELECTRICAL ENGINEER, but it will not be out of place to speak of its mode of operation again. The construction of the transmitter is very simple, consisting of a carbon ball resting in a metallic run-way and a small carbon point held in an aluminum cup on a mica diaphragm. At every pulsation of the diaphragm a clean break is made between the electrodes, so that it is claimed that they in no way can be interfered with by the Berliner patent, which is supposed to cover all forms of battery transmitters in which the electrodes are in constant contact. Amongst other forms shown was their new Style D, Fig. 2, which is very compact and contains the battery and transmitter all in one box, together with the magneto call bell. Models were shown which demonstrated that the ball did recede from the point, making a clean break, proving that the electrodes are separated in ordinary conversation. The United States Telephone Construction Co. are prepared to supply all apparatus necessary to put in a complete exchange, which they claim to be absolutely non-infringing.

The switch board shown, manufactured under the Gould-Smith patents, contains a good many interesting features, full illustrations of which are herewith presented. The board is very compact, 100 subscribers being grouped in a space of only 18 inches square. It is stated that there are no infringing devices used on the board, and there were none which were apparent to the ordinary observer. There are no drops, no clearing-out devices, and no lightning arresters are used, because they are not necessary. In this board every subscriber has his own plug and cord, so that half the subscribers can be talking with the other half at one time. In other words, all subscribers can be talking simultaneously, which, it is asserted, is not true of any other board now in existence. A very interesting test was made showing that electric light wires and lightning could not burn out the board. A 110-volt current, which was the only one obtainable in the building, was repeatedly turned on the terminals, which automatically acted, and took off the "ground," thus preventing damage. It is said that in actual working, boards built on this principle have been struck by lightning, and that an arc current of 2000 volts has also been turned on without damaging the board, the reason being that the automatic action releases the cord and cuts off the ground connection so that the in-coming current must find some other means of outlet. In view of the recent patent decision it is certainly very interesting to see a complete system, operative in all its parts, yet designed with the express purpose of relieving its owners and users of all worry and anxiety on the score of infringement.

Fig. 1, herewith represents the appearance of the front of the Gould-Smith switch board with three subscribers' terminals in view. It will be seen that there are no drops or clearing-out devices of any kind. Unlike other boards, each subscriber has his own cord and plug. When a subscriber rings up central the automatic action releases his plug, and it springs forward towards the operator with a sharp click, taking the position shown in Fig. 3. The operator puts her finger to the terminal and pushes it back, at the same time asking "What number?" This operation is so quick, that the subscriber scarcely has time to put the receiver to his ear.

Fig. 4 shows that subscriber No. 1 has been connected to No. 2. The operator pulls out the plug of No. 1, inserts it in the end of plug No. 2, and forces them both back; they are now automatically locked. At the same time, the operator presses her foot on the pedal which rings the called subscriber, so that only a few seconds elapse between the subscriber's ring and the ringing up and connecting of the called subscriber with the one calling. As soon as the connection is established the operator cannot listen to, or hear, any of the conversation, nor can she disconnect the subscribers until they are through talking and themselves ring off.

Fig. 5 shows the same connection as No. 3 after the subscriber has rung off. It will be seen that the two plugs which are connected, are both automatically ejected upon the subscriber ringing off. The same action which forces these plugs automatically from the board takes place if an arc light wire, or any other wire carrying a heavy current comes in contact with the telephone wires, so that every terminal is its own lightning arrester. It is impossible for high potential currents to injure this board, as the instant the current reaches the coil, the armature is attracted releasing the automatic action, and the line is opened.

To sum up the particular features of this board differing from others in common use, the following advantages are claimed: No drops or aprons are used, no weights, no spring jacks or sockets. No test circuit is required, no key board of any kind, no extra clearing-out drops, no supplementary lightning arresters. In addition to this, great speed is claimed for the board, as only three motions are necessary to make the connection. The board is very compact, which is always a great advantage.

FIG. 2.—M. & B. TELEPHONE TRANSMITTER, STYLE "D."

Another point is that the operator's time is not taken up making daily tests, as every subscriber tests his own line when he calls up central. In short, the board marks a distinct new departure in central exchange work; and is obviously a great advance on many existing methods.

A cut of the Gould-Smith Toll Line board for connecting outlying or distant towns is also shown in Fig. 6. In this board no plugs, cords or sockets are employed. This also is a metallic circuit board, the connections being made by a rubbing spring contact.

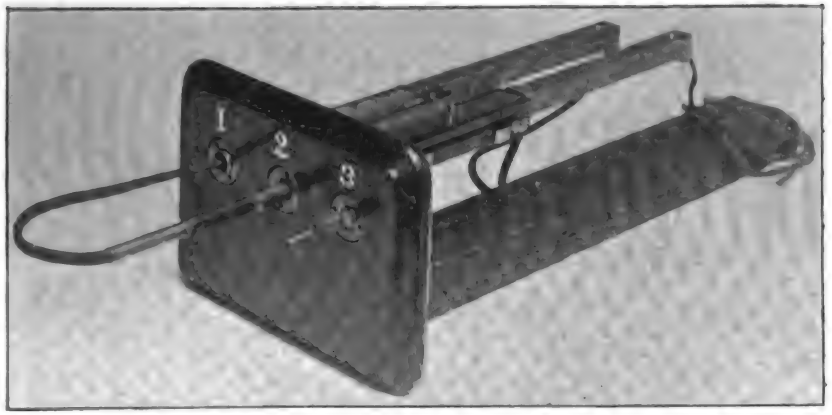


FIG. 5.

FIG. 4.

NEW "M. & B." TELEPHONIC APPARATUS
FOR EXCHANGE WORK.

(Figs. 3, 4, 5 and 6.)

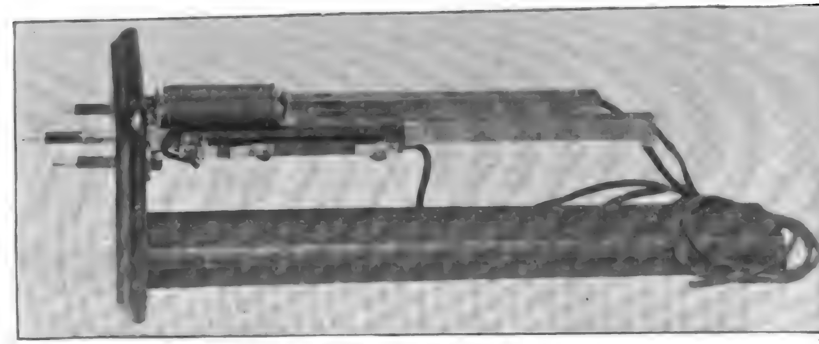


FIG. 3.

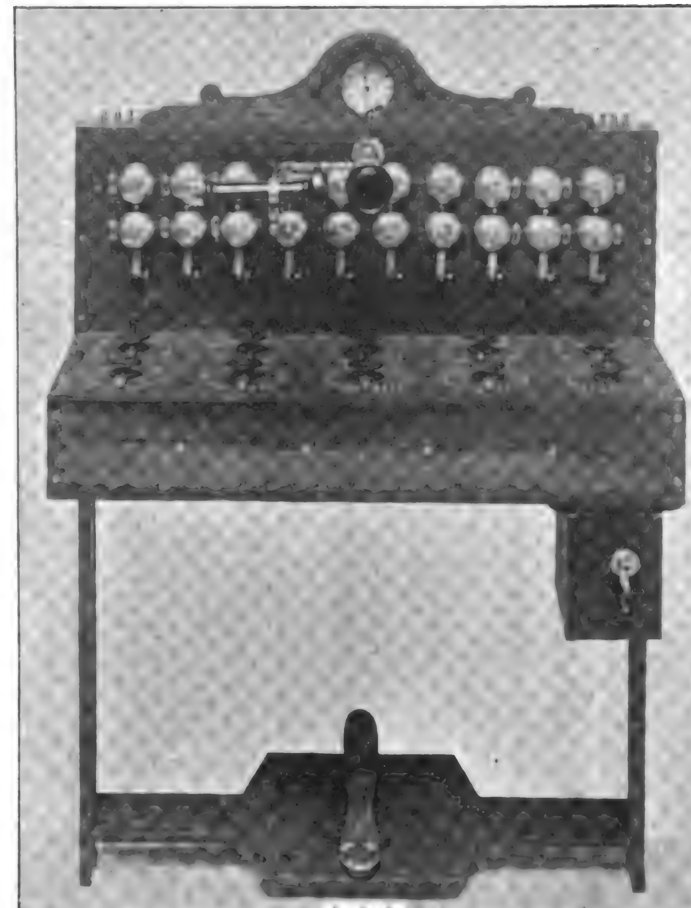


FIG. 6.

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EDITORIAL ANNOUNCEMENTS.

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Communications for the Editorial Department should reach it not later than Thursday. Copy for advertisements should be handed in not later than Friday.

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CONTENTS.

THE INSTITUTE MEETING.

If the number of attendants is any index of the success of a meeting, then the Twelfth General Meeting of the American Institute of Electrical Engineers held last week at Niagara Falls must be considered the most successful thus far in the history of that body. The selection of the place for this year's meeting proved to be eminently judicious, and while the natural beauties of Niagara no doubt acted as an attraction for many, the inference is fair that the great electric power development now undergoing its first test, and the desire to inspect and study it on the ground, probably acted as the reason that brought nearly two hundred members and their friends to Niagara. Nor did their expectations remain unfilled. Thanks to the courtesy of the Cataract Construction Co., the Institute was the first body admitted as such to the great power house, and its members were thus afforded an opportunity of judging for themselves of a work about which so much has been written and which has given rise to not a little controversy. The first impression which the sight of the 5,000 H. P. generators made upon the majority may be said to have been disappointing,—disappointing in the sense that there was so little to see. One is so accustomed to consider a 5,000 H. P. plant as an aggregation of boilers, engines, dynamos, pumps, feedwater heaters,—not to speak of the coal pile,—that the sight of a generator of such a capacity occupying a space barely 12 feet square and 13 feet high is apt to give one a nervous shock. It is true that the prime mover in the present case was not in view, being at a depth of 140 feet below in the pit, but even if both generator and turbine were placed side by side their simplicity and the space occupied by them, would be out of all proportion to that of a corresponding steam plant

The Institute was fortunate in eliciting at this meeting an authentic, though brief, history of the methods finally adopted in carrying out the work at Niagara, Dr. Sellers and Mr Stillwell giving, respectively, the details of the mechanical and civil engineering and the electrical engineering parts of the work. But the complete history of this justly celebrated work, we think, has still to be written, if we may judge from the highly interesting communication which we print this week from Prof. Henry A. Rowland, who for a time acted in an advisory capacity to the Cataract Co. While called forth by a personal difference with Prof. Forbes, this communication is none the less valuable as a contribution to the history of the evolution of Niagara's electrical power, and engenders the hope that we may soon be placed in possession of all the facts in the case, which now necessarily lie hidden in the reports in the hands of the Company. It is, of course, too much to expect the publication of the latter pending the full trial of the completed plant and a time test of the methods adopted; but these impediments will, we hope, be soon removed.

It may be noted, in passing, that before the Institute members had all left on Friday last, the work of actual transmission of power began, no less than 2,000 H. P. being sent to the Pittsburgh Reduction plant (already described in these pages), a distance of about three-quarters of a mile.

Particularly apropos of the time and place of the meeting was Dr. Emery's paper on "The Cost of Steam Power." We have of late had so much wild talk on this question, especially in the vicinity of Buffalo, that a calm consideration of the subject by a competent and recognized authority must go far towards putting the quietus on many of the absurd statements and figures which have gained currency. If we read Dr. Emery's figures correctly, a 20,000 H. P. plant of the most modern construction cannot compete in cost of power delivered *at the engine shaft* with the price of electric power delivered *at the motor terminals*, as actually contracted for by the Niagara Falls

Power Co. In other words we must add to Dr. Emery's figures the cost, interest, depreciation, etc., of the electrical machinery necessary to distribute the power of the steam engines in order to make the comparison complete; and when this is done, the disparity in favor of the Niagara power becomes still more pronounced. This remark is, of course, not intended as a criticism on Dr. Emery's paper, but we have thought it well to point out the fact in order to set the matter in a clearer light before those who have so strenuously insisted on the low cost of steam power as against the exceptionally favorable and very rare conditions obtaining at Niagara.

Considering the extent of electric railroading in the United States it is somewhat surprising that the meeting elicited but a single paper bearing on this topic, that of President Duncan's; but though standing alone it contains sufficient meat to set steam railroad managers thinking for some time to come. Of the conclusions reached by Dr Duncan, the third and fifth appear to us as describing the situation as it exists at present. For the steam roads to ignore electricity is simply fatuous, and when the figures for through and local passenger traffic as given in Dr. Duncan's paper are compared, it is seen that there can be but one answer to the question of the future operation of railways. As if to accentuate the force of Dr. Duncan's arguments, the announcement is made that the last of the big cable lines in Philadelphia are being abandoned to give place to the trolley. Surely it must be more than mere sentiment that dictates the abandonment of millions of dollars invested in machinery and cable conduits and the investing of large additional sums in new electric construction; and what cable roads have done steam roads will yet do with even greater propriety.

TELEPHONE UNCERTAINTIES.

Last week the organization of the "independent" telephone manufacturers was accomplished at Pittsburgh, and it now remains to be seen what the body will be able to accomplish. To some extent the association appears wanting in strength, and the meeting itself was somewhat of a disappointment; but no one can question the wisdom of Mr. Keelyn in pushing through his plan for united action against an enemy that has the vantage ground and so many of the sinews of war. The next move on either side will be awaited with interest; meantime the telephone industry is in rapid expansion. Indeed, in view of the long business depression, it is amazing that the activity should be so great. It merely shows how inadequately the wants of the public in general have so far been met.

But if the rally at Pittsburgh of the new forces was rather disappointing, the entrance of new factors into the field of telephonic contest supplies food for encouragement and hope as to the steady growth of an industry long repressed. As times improve new capital will find its way in, with more and more of specialization of product. It will not all be exchange work; nor will it all be interior work. The wants of the rural districts alone constitute an enormous market that has not been touched; while railroads, street railways, mines, ranches, and special lines all need attention. The long distance work presents, perhaps, the most important problem; for here would appear to lie the area for the next "irrepressible conflict." It is obvious that telegraph and telephone companies cannot long exist together on the present footing; and even now the rumors are bruited of trouble between the American Bell and Western Union, and of alliance between the Postal Telegraph and Standard Telephone interests. These reports are denied, of course, and even the bases for them are often obviously wrong; but the underlying instinct of the public that things cannot long endure as they are, with the telegraph slowly succumbing to the telephone, is entirely right. There must be an early re-adjustment. For example, the Bell-Western Union contract runs out next year, when it is hardly to be expected that the telegraph company will be satisfied with half a million dollars annually for sitting still and seeing its revenues sapped.

CONDUIT TRACTION IN NEW YORK CITY.

We illustrate this week the conduit system installed by the General Electric Co. on Lenox Avenue in this city. The road was visited and inspected recently by the New York Electrical Society, and the general opinion undoubtedly was that the working of the system was very satisfactory. Such is the view also formed by ourselves from constant observation during the past month, but it would be premature to make up one's mind until the road has gone through the ordeal of winter. Improvements of more or less value are in quiet progress, however, and by Fall the road should be ready for the test to be given it. Fortunately the trial will be made under the supervision of Messrs. Pearson and Hirt, both of whom are thoroughly well informed on electric traction and are entirely friendly to the use of electricity. It will be noticed that already the pedestal support of the conductor in the conduit has been exchanged for a suspension method, while the plough itself has been gradually modified, the better to meet the conditions.

What is known as the Love conduit system is also soon to have a trial in the upper part of the city, and from the interest shown we can only believe that the successful demonstration of conduit methods in the higher part of New York City will lead to an insistent demand for their adoption on a great many of the lines uptown and down.

POLITICS AND ELECTRICITY.

Why there should be any politics in the appointment of an electrical subway commissioner it is hard to see; but, granted there must be politics, it is equally hard to see why electrical engineers are not selected for such positions. The question is one we are now looking at from a local, New York, point of view, but it is one that crops up all the time all over the country. In New York, Mayor Strong has just removed Mr. Amos J. Cummings from a Commissionership of the Board of Electrical Control on the alleged ground that he is a Tammany man; and he has filled the vacancy with a Mr. T. L. Hamilton, apparently for no other reason than that he is a "Platt man," and friend of a gentleman popularly known as the "wicked Gibbs." Now Mr. Hamilton may be a worthy, respectable man, though his affiliations lead us into a little doubt on the subject. But we do not think that he would be proven any better, as a man, than Mr. Cummings; and if the latter is removed on political grounds, why replace him by another politician?

Had Mr. Cummings been removed because he was not an electrical expert, we should have been glad to approve the Mayor's action heartily; but as things are, the change is a discredit to a Mayor who came into office on a reform ticket, pledged to fill the offices without distinction of politics. Moreover, why did not Mr. Strong select an electrical engineer? We know that more than one good man was brought to his notice, quite capable of discharging the duties properly—which is more than can be said of a single subway commissioner yet appointed since the subway law went into effect.

The Board of Electrical Control is or should be an engineering body, just as the Board of Health is a medical body. While we do not insist that its every member should be an electrical expert, we do insist that at least one member should be an engineer, and that the Commissionerships are not mere political spoils, for the greediest retainers of unscrupulous leaders. Such events as this are, however, but mere casual samples of what would happen with full municipal control of every enterprise.

Letters to the Editor.

PROF. ROWLAND AND THE NIAGARA PLANS.

In the English journal, *Lightning*, sometime ago was published an interview with Prof. George Forbes which contains statements about my connection with the Cataract Construction Co., so far from the truth that I cannot allow them to pass without a brief statement.

In making this statement I am, of course, hampered by the necessity of only mentioning those facts which have, in various ways, become public property.

My first report was made to the company in 1889, not 1890, as Prof. Forbes states. In this report the questions submitted to me were very limited. Suffice it to say that I *did not* report against the alternating current system but said instead that it had a "great future before it," but that at that time it was not in a commercial state and, indeed, neither was the continuous current system, for such an enterprise. I advised the company to wait and study the problem for a time. This I regard even now as most excellent advice.

If Prof. Forbes, more than a year later, was able to report definitely in favor of the alternating current system I am not surprised after the immense strides made in the subject during the interval between our reports.

When called upon again in the summer of 1892, I found that the company were ready to decide upon their final plans, and that they wished my opinion principally upon the scheme devised by Professor Forbes himself. Thinking that I could readily agree with a gentleman who had examined all the systems of the world, I consented, thinking it all a mere form.

When, however, I came to examine the plans, I found that I could not agree and I would have gained peace and freedom from the most disagreeable experience of my life if I had done so. But I regarded it as cowardly to withdraw and, as I had agreed to give my opinion, I did so in words scientifically true and exact.

It is not to be supposed that I went into this enterprise as an electrical engineer to give advice on details, but only as an electrical expert to decide on the general system to be used and the company to carry it out. The Cataract Company knew that there were many, including Prof. Forbes, who were more familiar with details but they wished me to study the subject from a general standpoint and give them my judgment on it.

The main subject that I had to consider was Prof. Forbes' report to the company dated Sept. 16th, 1892, giving his final recommendations to the company.

As this report was handed to me confidentially I only feel at liberty to quote the final specifications as these have been made public by the action of the company in sending them to those who were to bid on the plant, as well as in other ways.

Specification.

"Each dynamo is to be of such size that it absorbs 5,000 H. P. of mechanical energy on the shaft. It is to be supported on a vertical shaft working in adjustable bearings; speed 250 revolutions per minute. The revolving parts of the dynamo must weigh not over 10 tons and must be perfectly balanced. The top bearing must be supported in a thoroughly substantial manner. The dynamo is to generate alternating currents with 8⅓ complete periods per second. The armature coils to consist of 8 coils, 4 in what we may call phase A, and 4 in phase B, which is in quadrature with phase A. The 4 coils in either of these circuits can be connected in series or in parallel or 2 in series and 2 in parallel, thus giving at will either 2,500, 5,000 or 10,000 volts.

"The armature must have no revolving iron. The conductors revolving between pole faces are to be vertical and are to be driven and supported by driving pieces rigidly connected with the shaft and so designed that Foucault currents do not unduly heat them. The losses due to copper resistance, Foucault currents and hysteresis, are not to exceed 2 per cent. of the maximum output. Rises in temperature of the armature conductors not to exceed 80 degrees Fahrenheit. Insulation throughout to be of mica, and must be subjected, through mechanical strain or changes of temperature, to no shearing stress."

These recommendations can be analyzed as follows:

1st. The two-phase alternating system was to be used.

2nd. Very light revolving parts, *not exceeding ten tons in weight*, to be used.

3rd. No iron to be used in the armature, but only bare revolving copper bars.

4th. No transformers to be used at the dynamo, but 10,000 volts to be obtained direct from the dynamo.

5th. A period of 8⅓ per second.

These specifications were accompanied by a design embodying them in a concrete form and showing that the copper bars were parallel to the axis.

With the exception of the first recommendation to use the two-phase system, I condemned the whole scheme, and said that a dynamo built after Prof. Forbes's drawing would not last a month, if it did a week.

The tremendous racking stress on each coil at the low period of 8⅓, the coil being of copper bars parallel to the axis without iron around it, all at a potential of 10,000 volts, was certainly sufficient to make me use very plain language. Again, the light revolving parts would cause such unsteady motion that I recommended them to be of larger diameter and weighing not less than 25 tons.

The system at Niagara to-day does not contain a single feature that I condemned. The whole of what Prof. Forbes intended as his final report has been swept away. One feature alone remains, the use of the two-phase system, and to this I agreed.

The system that I recommended is practically that in use at Niagara to-day in spite of Prof. Forbes's opposition to the very last.

The revolving parts are heavy, the armature contains iron, transformers to obtain the highest potential are to be used and a period of 25 per second has been adopted. The exact figures, however, have been somewhat altered. My "not less than 25 tons" for the revolving parts have become 40 tons, and my period of 42 or 33 has gone down to 25, and my revolving armature has become revolving magnets. As to whether the changes are for the better only time can show. As to whether 40 tons can be successfully revolved at 250 turns per second, a short time will decide. As to the charge of Prof. Forbes that I won my suit for the reason that the company had ordered my services though they did not act on my advice, the above is sufficient answer. I am perfectly satisfied with the extent to which the company profited by my advice.

But I have one word more to say, and that is with regard to the reason of my bringing suit against the company for so paltry a thing as a bill. Everybody who knows me at all knows that money forms a very small portion among the objects that I seek. But when men wish me to take my mind from those objects which I love, and devote it to their private money-making pursuits, I am then entitled to be compensated at the same rate as a first-class lawyer or physician. Furthermore, I have no right to degrade the profession of a man of science by undervaluing my services. Let everybody recognize that the successful pursuit of science requires quite as much brains and knowledge as that of law, and that a scientific error often equals in disastrous consequences a legal error.

Henry A. Rowland.

Johns Hopkins University, Baltimore, June 17, 1895.

PROF. DOLBEAR AS A TELEPHONE HISTORIAN.

Fig. 6.

When such well-known a scientific man as Professor Dolbear undertakes to pass judgment on the claims of rival inventors it is generally presumed that he is cautious enough to first post himself fully on the evidence of the cases he is dealing with. But, as not unusual, bias and personal grievances are the arbiters which guide the mind of some critics who undertake to pose as the historians of science. Professor Dolbear's heart beats for the down-trodden ones among the inventors. Bourseul is nowhere, Bell is nowhere, Edison and Berliner ditto. It is Reis and Hughes, the others are imitators and are to be classed with the rank and file of the hundreds who merely make improvements and receive patents therefor.

To open up the Reis-Bell controversy would lead to no results; the adage of "convincing one against his will" holds good in this case. But since it first filled the electrical press a new generation of electrical men have sprung up, and a short rehearsal of facts might be in place. Here is the inside history of Reis's pretensions.

In 1854 when Reis lived in Frankfort and was an active member of the Physical Society of that city, a prominent Frankfort paper called "Didaskalia" under the heading "Electrical Telephony" printed a leading article giving a full account of Bourseul's ingeniously conceived break and make transmitter and magneto receiver. And five years later Mr. Reis made such an apparatus as Bourseul had described, got musical tones, together with what at rare intervals appeared like a semblance to human speech—in spite of the intended breaks—and in his autobiography Reis modestly remarked: "*I called this instrument Telephone.*" The coincidence of the name thus coined by Reis with the heading "Electrical Telephony" of five years before is most remarkable, and the resemblance between the Reis apparatus and Bourseul's description still more so. But this should not be surprising because another claimant for the Speaking Telephone, named Daniel Drawbaugh, once swore that he invented a complete Blake transmitter, box, coil, springs, castings and all, in 1876, before Bell's magneto telephone was fairly completed. Why then not make it Reis, Drawbaugh and Hughes?

Well, for those performances of Mr. Reis he received that justly celebrated monument with the inscription "The Inventor of the Telephone," and to further flatter German national vanity his widow received a pension from the German government. On

the other hand Bell was refused a patent by the German Patent Office under the pretense because a few days before he applied for it, he had published his ideas in print.

But now a new allegation is made by Prof. Dolbear. Hughes, he says, was the first to use a piece of hard carbon for a contact transmitter.

If Prof. Dolbear had tried to search for facts he would have found that Mr. Berliner on Sept. 10, 1877, filed an amended drawing showing as Figure 6 the combination of a plate of hard carbon on a vibratory electrode in loose contact with a vibratory metal electrode, an embryo Blake transmitter contact.

Now Edison must have antedated Berliner because in the interference on the carbon contact Edison carried his record several weeks back of Berliner's record and received the patent.

Six months later then Sept. 10, '77, came Hughes, and made much noise and great pretensions. He coined the word "microphone," forgetting the iron principle that sound, being the sum of time and force, you cannot change its loudness except at the expense of quality. He mistook the incidental admixture of foreign sounds with the one to be transmitted, for an increase of the latter and without considering that he merely brought the sound closer to the ear drum. For that he is lauded by Prof. Dolbear and others as the inventor of the loose contact carbon transmitter.

Is there anywhere greater and more persistent injustice?

From the testimony in the Berliner Case it also appears that Berliner in Sept. 1877 spread broadcast a printed memorandum in which a loose carbon contact was described.

All this is on public record, right in the Boston Courts, near Prof. Dolbear's home, and the headquarters of the Bell Telephone Company, and it is inconceivable how a man of Prof. Dolbear's position can undertake to write History with so little regard to facts and fairness.

At one time Prof. Silvanus P. Thompson wrote in a similar strain to that of Prof. Dolbear and published a book "Reis the Inventor of the Telephone." But then Thompson had been retained by a rival telephone concern and for that reason allowance was made for his excursions into the land of sophistry. But what excuse has Prof. Dolbear for this fresh tirade against the merits of Bell and his co-laborers?

WERNER SUESS.

WASHINGTON, D. C., June 22, 1895.

TWELFTH GENERAL MEETING OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, NIAGARA FALLS, JUNE 26-30.

TUESDAY SESSIONS.

The twelfth general meeting of the Institute was called to order in the parlors of the Cataract House by the secretary Mr. R. W. Pope, who in the enforced absence of the retiring president, Prof. E. J. Houston, introduced the newly elected president, Dr. Louis Duncan, who took the chair amid applause.

THE PRESIDENT introduced the Mayor of Buffalo who welcomed the members of the Institute in a short address, and the reading and discussion of papers was then proceeded with.

The first paper read was that by Mr. W. E. HARRINGTON, on "Properties of Fuse Metals when Subjected to Short Circuits,"[1] which was followed by a lively discussion.

DR. L. WALDO thought that great caution ought to be observed in the use of aluminum fuses, as a slight admixture not exceeding 2 per cent. of iron or silicon raised its resistance to three times that of the pure metal. Frequently, also, copper and nickel were added to aluminum to make it draw better. MR. C. P. STEINMETZ thought that the constants obtained by Mr. Harrington held good only for the length of fuses employed in the tests, but did not apply generally to other fuse lengths. He did not think copper a suitable metal for fuses, owing to its high fusing point, except in special cases such as in electric car work. MR. C. J. REED believed that a fuse metal ought to have a low resistance instead of a high one, because its mass would then be less, and it would throw around less metal. PROF. W. A. ANTHONY criticized the paper on the ground that the author had assumed the resistance of the connections as negligible, which he deemed not to be the case, so that other results might have been attained with less resistance as a whole. PROF. ELIHU THOMSON believed that much depended on what the fuse was intended to do; if it was intended to protect merely for an overload, a lead tin fuse would be best. If intended to guard against a short circuit, copper would be best. MR. BLODGETT expressed the opinion that no formula with a single constant could express the law, as it depended upon the length of fuse and the duration of time. DR. A. V. GARRATT did not agree with the sweeping assertion of Mr. Harrington that fuse metals are to be depended on under no circumstances, but thought that they did protect under some. CAPT. WM. BROPHY was in general accord with the author's experience, but would modify Mr. Harrington's assertion to the extent that fuses are not to be depended on "under *most* circumstances." In his 12 years' experience he had tested common fuses and none of them had come anywhere near what they were advertised at. The discussion was also taken part in by PROF. F. B. CROCKER and others on similar lines.

1. See page 7 this issue.

This was followed by the reading by MR. C. P. STEINMETZ of his paper on "Theory of the General Alternating Current Transformer," which was discussed by DR. M. I. PUPIN. Mr. Steinmetz also referred to the fact that in his laboratory at Schenectady he had a machine, a sort of maid-of-all-work, which could be variously connected as an induction motor, a transformer, a two or three phase generator, or for converting from two to three phase, etc. PROF. DAVIS also took part in the discussion.

MR. C. E. GIFFORD, then read his paper on the "Location of Grounds in Armatures, Fields, etc." The meeting then adjourned until evening.

In the afternoon the members took carriages and were driven to the power house of the NIAGARA FALLS POWER CO., where they were afforded every opportunity for inspecting the apparatus there installed, which was fully described and illustrated in THE ELECTRICAL ENGINEER of June 26. One of the large 5,000 H. P. quarter phase generators was run with an artificial load of over 3,000 H. P. which was varied in order to demonstrate the sensitiveness of the regulator controlling the gates of the turbine. The switchboard gallery has just been equipped with the new "Niagara" type Shallenberger voltmeter, ammeter, and watt-indicator, described in THE ELECTRICAL ENGINEER of Jan. 2, 1895. There was also to be seen, though not erected in position, the table for controlling the main and field switches of the 5,000 H. P. generators. These will be operated by compressed air controlled by handles on the gallery table. Most of the members also descended to the bottom of the turbine shaft in the Otis electric elevator. The substantial character of all the work was commented on by all present.

The works of the PITTSBURGH REDUCTION CO. was the next point visited, the power room being alone opened to the visitors. This room was described and illustrated in our last issue.

THE CARBORUNDUM CO.'S WORKS, close beside those of the Pittsburgh Reduction Co., presented little of interest as the machinery has not yet been installed.

The electric light station of the BUFFALO & NIAGARA FALLS LIGHT & POWER CO. was visited by the members, some of whom also inspected the mills of the Niagara Falls Paper Co., close by, which take 6,000 H. P. direct from turbines.

THE evening session was opened by Prof. W. A. Anthony. He introduced PRESIDENT DUNCAN, who read his inaugural address entitled "The Substitution of Electricity for Steam in Railway Practice."[1]

In the discussion which followed MR. STEINMETZ discussed the limits of availability of the continuous and alternating current railway motor. He believed that for city street railways the 500 volt continuous current motor would hold the field against all comers; but on long suburban and interurban roads the alternating current would displace the continuous, being operated, either through the medium of rotary transformers with continuous current motors on the cars, or with alternating motors fed from stationary transformers. Of course the continuous current motor was preferable, because it could be used anywhere, and it was true that the alternating motor required two trolley wires; but on the other hand with stationary transformers any voltage can be used. He also advocated an underground railway conduit system at 110 volts. Mr. Steinmetz also exhibited curves showing the results of tests on a 3-phase railway motor which showed a torque of 1,600 lbs. at ½ speed, 2,800 lbs. at full speed and a maximum torque of 8,000 lbs. acting on a 33-inch wheel, a torque, comparable to that of the largest steam locomotives. This machine was designed for 110 volts.

MR. OBERLIN SMITH believed that contrary to Dr. Duncan's view railways electrically equipped could handle freight as well as passengers. DR. DUNCAN in reply stated that there was no question as to the possibility of electric roads handling freight as well as passengers, but that steam roads were not in condition to undertake such electric traction at the present time. He believed that to meet the competition of parallel electric roads they would either have to build two additional tracks electrically equipped or buy out the competing electric roads.

PROF. ELIHU THOMSON then read his paper on "Compounding Dynamos by Armature Reaction."

SECRETARY POPE announced that the Long Distance Telephone Co. had placed all its lines throughout the United States at the disposal of the Institute members.

WEDNESDAY SESSIONS.

The day's meeting was opened by the reading of the paper on "Electric Power in Factories," by Prof. F. B. Crocker and Messrs. Benedict and Ormsbee. Prof. Crocker also exhibited curves illustrating the amount of power used in a certain factory operating shafting by belting. At noon time the shafting alone was run, when it was shown that the latter absorbed three-fourths of the total power of the engine. DR. C. E. EMERY showed, how, by

1. See page 8 this issue.

electric driving any department in a factory could be run overtime without loss. He did not believe that any hard and fast rule could be laid down as to whether each machine should be equipped with its individual motor, or each set of machines with a section of shafting electrically driven. MR. H. WARD LEONARD related his experience in driving a cloth printing roll, which had been successfully accomplished, and resulted in the displacement of a steam engine used for the purpose. MR. G. S. DUNN believed that the great loss of 80 per cent., found in shops driven by shafting was due to the fact that the tools are in use only a fraction of the whole time. He did not consider 75 per cent too high a loss, and had known of a case as high as 85 per cent. In the new shops of the Crocker-Wheeler Electric Co., the conductors will be run under the floor and brought up at each machine. The discussion was also participated in by MESSRS. WHEELER, BLODGETT, ALEXANDER and BROPHY.

MR. C. P. STEINMETZ then read his paper on "Some Features of Alternating Current Systems," which elicited no discussion.

SECRETARY POPE announced that the resolutions adopted by the Institute in memory of the late treasurer, MR. GEORGE M. PHELPS, had been engrossed, and they were placed on view in the hall.

The paper of PROF. D. C. JACKSON and MR. S. B. FORTENBAUGH on "Some Observations on a Direct-Connected 800 Kilowatt Monocyclic Alternator,"[1] was then read by MR. FORTENBAUGH, and briefly discussed by MESSRS. DUNN and STEINMETZ.

In the afternoon the members took a special train placed at their disposal by the Niagara Falls Park and River Railway and made the trip to Queenston and Chippewa, stopping at the Whirlpool Rapids, the Power House and other points of interest along this excellently equipped electric railway.

The evening session was taken up with the paper of DR. C. E. EMERY on "The Cost of Steam Power—II." In the discussion which followed PROF. ANTHONY pointed out that the Niagara Falls Power Co. proposed to base their charge on the maximum power used as determined by meter, and hence it would be unfair to a consumer since the average power used is usually far less than the maximum. PROF. CROCKER believed that the low cost of power which one frequently hears of is due to the fact that power users figure by taking the total cost and then dividing by the maximum power of the plant, instead of dividing by the average power developed. DR. EMERY stated that the Niagara Company proposed to sell undeveloped power at $10, power at turbine shafts for $18, and electric power at dynamo terminals for $18 per H. P. per year. Mr. L. B. STILLWELL thought that in order to make a fair comparison the cost of electric generators, etc., should have been added to DR. EMERY's estimates. MR. B. J. ARNOLD pointed out the fact that in well designed electric central stations energy was now delivered at the switch board for 1 cent per H. P. hour. The discussion was also taken part in by MESSRS. SMITH, PERRY and GARRATT.

THURSDAY SESSION.

The morning session was opened by DR. EMERY, who supplemented his paper read the evening before by instancing a case which had came under his observation, in which electricity did not figure out as the most economical means of transmission, owing to the fact that the heat of the exhaust steam was utilized and constituted the larger portion of the work.

DR. A. M. BLEILE, then read his paper "On the Cause of Death in Electric Shock,"[2] which elicited quite a lively discussion. Referring to the observed fact that little or no bleeding was seen after incision into the animal's body after death from a low frequency current, PROF. ELIHU THOMSON suggested that high frequency currents might be used for the resuscitation of persons shocked by electricity since experience had shown that a wound made immediately after the application of a high frequency current bled very freely. In reply to a question by PROF. ANTHONY, Prof. Thomson said that experiments made by him seemed to prove that high frequency currents did actually pass through the body and not merely along the surface as was generally supposed. MESSRS. BLODGETT, NEHER and GARRATT also participated in the discussion.

MR. G. H. WINSLOW was then introduced and read his paper on "Long Distance Power Transmission at 10,000 volts (the Pomona, Cal., Plant), describing a transmission over 28¾ miles.

DR. C. E. EMERY read his paper on "Alternating Current Curves," after which the members adjourned to the hotel porch and were photographed in a group.

The afternoon was spent by the members in visits to the Observation Tower, which affords a magnificent bird's-eye-view of the Falls and surrounding country; to the Buttery Elevator at the Whirlpool Rapids, and other places of interest which had been thrown open to them for the occasion.

The evening session was opened by the reading, in abstract, of MR. F. L. POPE'S paper on "Notes on the Reconstruction of a Small Station Plant." DR. EMERY thought the paper worthy of special attention as a typical engineering paper, in that it showed the steps followed and the reasons therefore.

1. See page 4 this issue. 2. See page 6 this issue.

The President then introduced DR. COLEMAN SELLERS, who gave a most interesting account of the mechanical and civil engineering features of the great Niagara water power project, and pointed out the reasons which had dictated the designs adopted. He concluded by remarking that thus far all the expectations of the projectors and designers had been fulfilled, and that if any mistakes had been made they related only to very minor points. Dr. Sellers' address was illustrated by views and diagrams thrown on the screen by a lantern.

He was followed by MR. L. B. STILLWELL, electrical engineer of the Westinghouse Co., who also, by means of the lantern, described the electrical features of the Niagara plant.

FRIDAY SESSION.

THE closing session of the meeting was opened by a discussion of Dr. Emery's paper on "Alternating Current Curves" which was participated in by PROF. PUPIN and MR. STEINMETZ.

MR. W. L. R. EMMET then read his paper on "Existing Commercial Applications of Electric Power from Niagara Falls," in which he described the apparatus furnished by the General Electric Co. to the Niagara plant. The paper brought out a very lively discussion.

MR. B. G. LAMME criticised the general construction of the machines installed in the works of the Pittsburgh Reduction Co. and compared the rotary transformers there employed with similar ones used in the Niagara power house for exciting the 5,000 H. P. generators. He also criticised the use of copper brushes on the rotary transformers of the Pittsburgh Co. and believed that carbon brushes ought to have been employed. In reply, MR. EMMET stated that the machines were designed to conform to fixed specifications furnished by the Cataract Construction Co., and that these were adhered to to the letter.

After adjournment a number of the Institute members attended an exhibition of the BURTON ELECTRIC FORGING PROCESS in which the metal is heated under water. Mr. J. O. Adsit of the Burton Electric Forging Co., explained the process.

The names of those in attendance are:—

A. V. Abbott, A. Ackermann, Jos. S. Alden, Harry Alexander, H. S. Anderson, Geo. F. Archer, B. J. Arnold, Prof. W. A. Anthony, H. D. Bayne, W. D. Bayne, Eskie Berg, E. J. Berg, G. H. Blaxter, A. M. Bleile, Geo. W. Blodgett, W. J. A. Boucher, Frank Bourne, T. D. Boyles, W. A. Brackenridge, Chas. S. Bradley, E. Carl Breithaupt, Frank Brewer, William Brophy, James Burke, C. C. Burr, F. C. Busch, F. C. Caldwell, Henry S. Carhart, A. D. Chandler, Prof. C. F. Chandler, Edward A. Colby, E. P. Coleman, Stephen L. Coles, Geo. W. Colles, Jr., C. C. Collins, C. L. Cornell, J. B. Cornell, Jr., Maurice Coster, H. A. Cragin, Dr. F. B. Crocker, Jos. F. Cummings, G. W. Davenport, Prof. J. E. Davies, H. M. Davis, D. de Lancey, Fred. De Land, A. A. Dion, Bert W. Douglas, J. D. E. Duncan, Dr. Louis Duncan, Th. C. Dunlap, W. K. Dunlap, Gano S. Dunn, William C. L. Eglin, William Elmer, Jr., Alfred Ely, Dr. Chas. E. Emery, W. L. R. Emmet, Thos. H. Feary, R. A. Fessenden, H. W. Fisher, H. Foltz, M. Foltz, A. Fortenbaugh, S. B. Fortenbaugh, Horatio A. Foster, W. G. Fuller, A. V. Garratt, C. E. Gifford, S. R. Gifford, J. W. Gilmore, D. L. Goff, S. D. Greene, J. L. Hall, W. J. Hammer, W. J. Hamilton. Jr., Walter E. Harrington, Harold Hakenson, J. R. Haskin, E. H. Heinrichs, Carl Hering, Charles E. Hewitt, Charles K. Hugnet, Charles B. Hunt, F. S. Hunting, L. E. Imlay, J. Jordan, John L. Kepler, W. W. Ker, B. S. Lamphear, H. Ward Leonard, William B. Lester, P. M. Lincoln, Herbert Lloyd, R. McA. Lloyd, Dr. Walter Lobach, Jos. Lyman, D. N. McBrier, R. D. McCarter, Ralph McNeill, Prof. A. Macfarlane, Robt. B. Mann, E. B. Merrill, Percival R. Moses, Jules Neher, W. W. Nicholson, Alexander F. Ormsbee, Max Osterberg, Prof. R. B. Owens, Charles P. Peret, L. Knowles Peret, Frank C. Perkins, Nelson W. Perry, Walter M. Petty, R. Pfund, F. M. Pike, Charles Plumb, C. P. Poole, Franklin L. Pope, Ralph W. Pope, H. Hobart Porter, Jr., Dr. M. I. Pupin, George A. Redman, C. J. Reed, Harry D. Reed, H. G. Reist, E. W. Rice, Jr., J. W. Rogers, T. R. Rosebutgh, M. R. Rothschild, Wm. M. Rutherford, C. W. Ryan, E. N. Sanderson, Charles F. Scott, A. B. See, Coleman Sellers, H. B. Shallenberger, O. B. Shallenberger, John C. Shedd, Oberlin Smith, Charles P. Steinmetz, L. B. Stillwell, Henry T. Stott, H. B. Sweet, E. V. Swenson, H. W. Swetland, W. S. Symington, F. Taft, Prof. B. F. Thomas, Elihu Thomson, C. Thordarson, J. W. Tillinghast, Chas. A. Tinker, F. Torchio, C. R. Van Trump, Horace S. L. Verley, John Waring, Leonard Waldo, A. B. Weaver, W. D. Weaver, Edwin R. Weeks, Joseph Wetzler, Dr. S. S. Wheeler, J. C. White, E. F. Williams, George H. Winkler, Jr., G. H. Winslow, George P. Wisdom, G. C. Wolverton, Peter Wright, Alex. Jay Wurts, T. H. Yawger, Charles I. Young.

The ladies present were:—

Miss Alexander, Mrs. E. Bayne, Mrs. H. D. Bayne, Mrs. C. L. Cornell, Mrs. J. E. Davies, Mrs. H. A. Foster, Miss G. Fraser, Miss E. Fraser, Mrs. C. E. Gifford, Miss E. Gumming, Mrs. Chas. B. Hunt, Mrs. W. W. Ker, Mrs. Herbert Lloyd, Miss Maud Noble, Miss D. Osterberg, Mrs. Nelson W. Perry, Miss Perry, Miss Plumb, Mrs. M. I. Pupin, Mrs. George A. Redman, Mrs. F. Torchio, Miss Ruth Weeks, Mrs. H. R. Wemple.

THE FISKE POSITION FINDER.

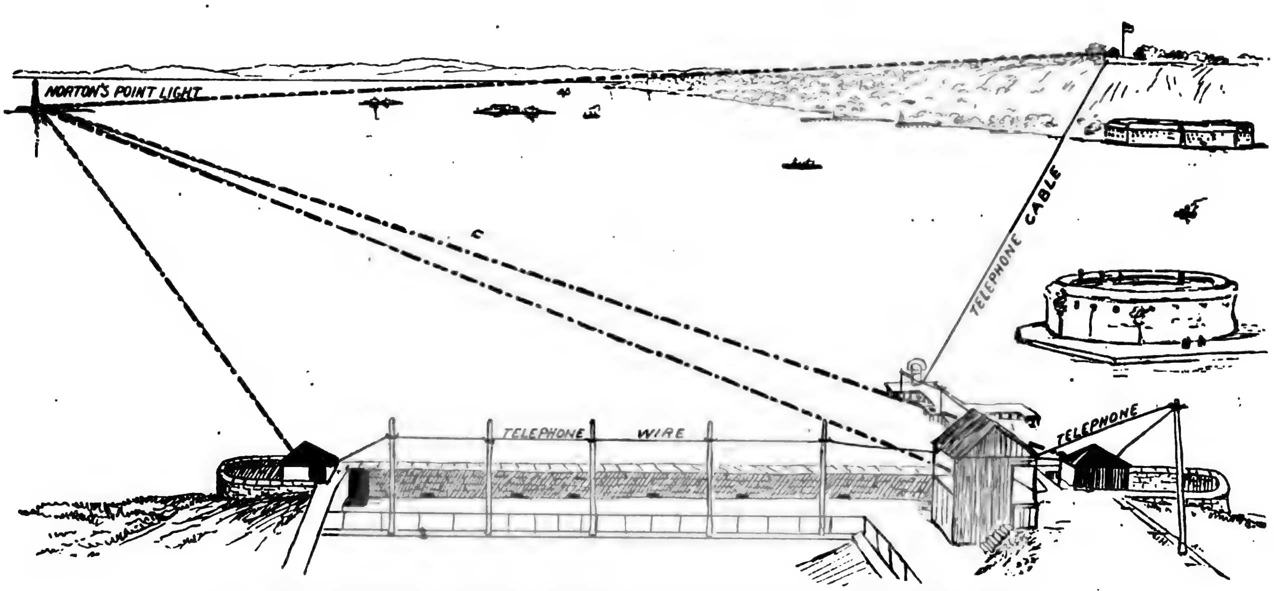
In our issue of April 12, we described Lieut. Fiske's range finder as it is now used in the U. S. Navy. On June 25th there was an official test at Fort Hamilton, New York Harbor, of Lieut. Fiske's new position finder, which differs from the range finder in this respect: the range finder is simply an instrument which finds the distance of the target from itself; while the position finder locates upon a chart the position of the target; that is, its distance and direction from some given point. Usually, but not

THE FISKE POSITION FINDER.

necessarily, this given point is one of the instruments of the position finder. The test undertaken at Fort Hamilton by the Board appointed by the Ordinance Department was for making estimates by the position finder of the range and direction of various objects, and comparing them with a known standard. The standard adopted for the purposes of comparison was furnished by a set of triangulating instruments, one of which was at Fort Wadsworth on the Staten Island side of the Narrows, and the other at Fort Hamilton, the operators being connected by telephone. At each place there was a telescope mounted upon a heavy brass pedestal, which was divided accurately into degrees and minutes, and used to show the angle at which each telescope was directed. These two stations were about 2,100 yards apart. of the tests will not be known for some little time to come, but from the favorable impression produced at the test by the operation of the position finder there seems little doubt of its approval by the Board.

This instrument, besides finding the position at the moment, also predicts what the position will be a short time afterwards. The position of the object is plotted on the chart for 30 seconds, and these positions are joined by a line more or less broken. This line shows, of course, the track of the vessel or other moving body so that the prolongation of the line gives the direction in which it will move in, say, the next 30 seconds. By laying off on this prolongation of the line the distance equal to that which the ship traverses in the previous 30 seconds, the point is given where she will be at the end of the next 30 seconds. In military parlance, this process is termed "predicting the position." The position finder, then, may be said to be an elaboration of the range finder.

Range finders have been used some time for artillery and infantry purposes; at least their use has been attempted with partial success, especially in England, where a great deal of attention has been paid to the subject. Many forms of the range finder have also been tried on board ships but with indifferent success, until the appearance of the Fiske range finder, which is the only one that has made naval range finding really possible. Both range finders and position finders have been used with good results in forts in Europe, and more particularly in England, where many of the forts are upon high ground. The instruments have been for the most part based upon the solving of a right-angled triangle of which one side is the height of the instrument above the water, and the known angle is the depression of the telescope placed on the instrument and depressed below the horizontal at the water line of the vessel under observation. These instruments are used in a variety of forms all over Europe, and they work with considerable accuracy where the height is sufficiently great to form a good base. Their great enemy is the changes in the refraction of the atmosphere, which alter the direction of a ray of light coming from the object on the water to the telescope. Another difficulty in their operation is the smoke produced by the firing of the gun, which frequently hides the hull of the ship from the operator and covers the surrounding water with an impenetrable cloud. Where the land is so low that a sufficient eminence cannot be got for mounting an instrument of this character, recourse must be had to triangulation, using a horizontal base. Of course it would be bad from a military point of view to raise any conspicuous structure wherein to place the instrument. Siemens & Halske some years ago got out an instrument of this character in which tele-



TESTING THE FISKE POSITION FINDER AT FORT HAMILTON, NEW YORK HARBOR.

An elaborate system of sighting was adopted which enabled the telescopes at the different stations to be directed simultaneously at any desired point. Near the telescope was a chart carefully marked out in angles and distances. In making an observation upon a stationary point, such as the Coney Island Lighthouse, it was merely necessary to place two pointers, which were pivoted over the chart at the angles of the two telescopes. In the case of moving objects, such as steamers going up and down the Harbor, a signal would be arranged by telephone at which the observers at each end would sight the vessel at the same instant. The results obtained would be eventually worked out and plotted, and compared with those given by the position finder. The result scopes were placed at the ends of a base line of known length, and were connected together by electro-mechanical means, so that the movements of the telescopes in horizontal angles operated pointers, which indicated the distance and the direction. Another class of extremely complex position finders have been tried in Europe unsuccessfully. The complexity of the instruments was fatal. The slipping of a pawl, or the jumping of a ratchet, caused errors which were cumulative, as it was found impracticable to keep putting the apparatus at unison, as is done with the printing telegraph. By the adoption of the principle which Lieut. Fiske has worked out in his range finder, all difficulties of this nature were overcome, as there are no springs, or pawls, or

ratchet or making and breaking of contacts, because the indicator is a galvanometer whose indications depend simply upon the increase and decrease of current due to the movements of hard contacts over unbroken wires of high resistance.

A position finder of much merit, invented by Lieut. I. N. Lewis, and designed to operate with vertical base line was also placed in the hut seen to the left of the diagram showing the scene of the tests at Fort Hamilton. Readings were taken throughout the day with this instrument, which is based entirely on mechanical principles. It may be mentioned that one of the advantages of the Fiske position finder is that it can be used with a vertical as well as with a horizontal base, and in such case a 50-foot base would be sufficient for its operation. We are indebted to the New York *Sun*, for the cuts from its own admirable article on the test.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JUNE 25, 1895.

Alarms and Signals:—

Code Signaling Device, W. Rymer, Detroit, Mich., 541,505. Filed July 2, 1894.

Designed for use in connection with a steam or similar whistle, the signals being controlled by electricity, to give the signals required by any given code, automatically.

Burglar Alarm, C. M. Clark, New York, 541,719. Filed Apl. 12, 1895.

Consists of an electric circuit, containing a magnetic coil to influence the electric current, by a person moving toward or from the coil, a galvanometer arranged in the circuit, and an alarm controlled by the galvanometer.

Conductors, Conduits and Insulators:—

Combined Insulator and Fuse Holder, C. F. Scott and H. P. Davis, Pittsburg, Pa., 541,459. Filed July 16, 1894.

A form of combined insulator and safety plug or fuse holder available for outdoor use.

Protector Casing for Underground Electric Conductors, J. A. Kingdon, London, Eng., 541,552. Filed Aug. 9, 1894.

Protects the conductor by an inverted U-shaped metal trough closed at the bottom and having sleeves at the abutting sections.

Distribution:—

Transmission of Power by Alternating Currents, F. S. Hunting, Fort Wayne, Ind., 541,615. Filed Jan. 19, 1895.

Provides a means for generating di-phased currents at the point to which the power is electrically transmitted, whereas only simple or mono-phased currents are produced at the point where the energy is generated.

Dynamos and Motors:—

Electric Elevator Apparatus, F. B. Perkins, Boston, Mass., 541,497. Filed Dec. 15, 1893.

The combination with the motor, rheostat and switch controlling the circuits of the motor, of a brake magnet included in the circuit, the arrangement being such that as the circuit is closed to start the motor a greater portion of the current shall flow through the brake magnet to operate the same.

Electrical Controller for Motors, O. H. & A. F. Pieper, San Jose, Cal., 541,500. Filed Apl. 30, 1894.

Means for controlling electric dental, surgical or other electrical apparatus of the kind.

Electric Brake Controller, F. E. Herdman, Winnetka, Ill., 541,545. Filed Dec. 18, 1894.

When the current passing through the armature of the motor for any other reason becomes excessive, the electric circuit to the armature is automatically opened and the brake automatically applied.

Alternating Current Motor, R. Eickemeyer, Yonkers, N. Y., 541,604. Filed Sept. 28, 1891.

Relates to a system of winding for single phase currents intended especially for light service work, such as electric meters and other measuring instruments.

Electric Motor, W. J. Still, Toronto, Canada, 541,641. Filed Aug. 9, 1894.

Details of construction to reduce hysteresis in the armature.

Device for Removing Resistances in Starting Electric Elevators, G. H. Whittingham, Baltimore, Md., 541,798. Filed May 24, 1894.

The gear of the elevator mechanism furnishes the power for operating the resistance controlling device.

Electrometallurgy:—

Electrolytical Process and Apparatus, C. T. J. Vautin, London, Eng. 541,465. Filed June 26, 1894.

Relates to the electrolytic production of an alloy of lead and tin with the alkaline metals.

Lamps and Appurtenances:—

Electric Arc Lamp, A. W. Smith, Washington, D. C., 541,460. Filed April 25, 1895.

In an arc lamp, a flexible feed ribbon, engaging with a retarding device on the movable carbon support, and means for imparting an up and down movement to the ribbon, and also means for varying the tension on the ribbon.

Repairing Incandescent Lamps, J. Möhrle, Munich, Germany, 541,421. Filed Jan. 25, 1895.

A process for inserting and securing the new filament in place.

Carbon Electrode for Electric Arc Lamps, S. Heimann, New York, 541,541. Filed Oct. 5, 1894.

A carbon electrode for electric arc lamps, in which are incorporated, infusorial earth, chloride of zinc, chloride of ammonia and yellow prussiate of potash.

Electric Arc Light, E. A. Edwards, Cincinnati, Ohio, 541,603. Filed Sept. 19, 1894.

Details referring to a locomotive head light.

Miscellaneous:—

Electromagnet, F. B. Corey, Boston, Mass., 541,471. Filed Apl. 15, 1895.

Relates to electro magnets designed for actuating apparatus in which a mechanical movement is effected by electrical means, and especially to such apparatus as requires that this movement shall be made slowly.

Automatic Electric Gas Lighter, W. N. Jaskey and E. S. Eise, Logan, Utah, 541,549. Filed Aug. 20, 1894.

Claim:—In an automatic electrical gas lighter the combination of a burner a fan support extending above the burner, a fan pivoted to the support and electrical contacts also mounted on the fan support arranged to be actuated by the movement of the fan.

Method of and Apparatus for Manufacturing Sulphuric Acid and By-Products, J. D. Darling, Philadelphia, Pa., 541,597. Filed Jan 8, 1895.

Consists in electrolytically decomposing a fused nitrate, directly conducting the disengaged gases, without further conversion, to the Glover tower, and recovering the basic residuum of the electrolytic action.

Process for Utilising Nitre Cake or Other Acid Sulphates, J. D. Darling, Philadelphia, Pa., 541,598. Filed Jan. 8, 1895.

Consists in electrically decomposing an electrolyte containing a similar base to that of the sulphate, and transferring said base to the sulphate by electrolytic travel.

Electric Gas Lighter, J. L. Creveling, New York, 541,723. Filed June 21, 1895.

Specially applicable to the "Pintsch" gas system.

Thermo Controlled Electric Heater, L. E. Custer, Dayton, Ohio, 541,724. Filed Dec. 22, 1894.

Especially designed for dental uses in the making of artificial teeth and plates.

Railways and Appliances:

Method of Preventing Electrolysis of Pipes Underground, H. P. Brown, New York, 541,467. Filed Dec. 10, 1894.

Claim:—The system or method of preventing electrolytic decomposition of underground pipes, consisting in maintaining said pipes in a negative condition in respect to the rails by connecting to the point on said pipes where there would otherwise be a positive potential, a feeder wire or conductor leading to the negative pole of a dynamo or other source of electrical energy, said pole having a greater negative potential than the rails.

Conduit Electrical Railway, E. Ebi, Cedar Rapids, Iowa, 541,730. Filed July 5, 1894.

Means of lowering or raising both wheels to throw them in and out of contact with the wires.

Trolley Finder, J. P. Taylor, Fort Worth, Texas, 541,796. Filed Mch. 12, 1895.

Switches, Cut-Outs, etc.:—

Fuse Block, H. P. Davis and C. F. Scott, Pittsburg, Pa., 541,473. Filed Oct. 23, 1893.

The vapors produced by the destruction of the fuse are disposed of in such a manner as to preclude any injury to the terminals between which the fuse is interposed.

Automatic Working Rheostat for Starting Electric Motors, F. E. Herdman, Winnetka, Ill., 541,543. Filed Nov. 24, 1894.

Automatic Working Rheostat for Starting Electric Motors, F. E. Herdman, Winnetka, Ill., 541,543. Filed Nov. 24, 1894.

Electric Motor, F. E. Herdman, Winnetka, Ill., 541,544. Filed Nov. 27, 1894.

Relates to a starting mechanism.

Electric Switch, W. P. Hancock, Everett, Mass., 541,608. Filed Feb. 7, 1895.

Relates to a double throw knife snap switch.

FINANCIAL.

STOCKS LOWER AND DULL.

The past week witnessed a dullness in electrical and other stocks that at last culminated in a decline, owing to the lack or support given. As a matter of fact, it cannot be said that the general market exhibited any decline in strength, but the symptoms were rather those of lassitude and reaction. An illness of two years is not to be rallied from in one summer month. During the week 38,600 General Electric shares were dealt in down to 35⅜ showing a net decline of ⅛, but quotations at one time went as high as 37½. The decline was even greater in Western Union which went off 1, and down to 91 on sales of 10,809 shares. American Bell Telephone was off to 195½ on Saturday. The stockholders of the latter company have voted to issue another $1,000,000 of stock, making the total capitalization $21,500,000 for the parent company alone.

OBITUARY.

ALTON J. SHAW.

The death is announced at Muskegon, Mich., of Mr. A. J. Shaw, president of the Shaw Electric Crane Co., at the early age of 37. He was educated at Auburn, Me., and graduated from Bates College. He went into the employ of the E. P. Allis Co., of Milwaukee, and there invented the well-known electric crane bearing his name, to which he had devoted his energies for some years past. He had great inventive ability with marked mechanical aptitude. He leaves a widow and a daughter. His illness, due to peritonitis, lasted only four days.

HENRY W. FRYE.

We regret to note the death at an early age of Mr. H. W. Frye, formerly associate editor of *The Electrical World*. He resigned his position some time ago utterly broken in health and went to New Mexico to recuperate, but consumption wrought its work swiftly. Mr. Frye was a most amiable and talented young man, and the profession to which he sacrificed his life is the loser by his untimely death.

J. S. O'Brien.—J. S. O'Brien, late superintendent of the Telephone and Electric Light Companies in Scranton, died at his residence in that city recently, aged 52 years. He began his career as telegraph operator for the Pennsylvania R. R. at Greensburg, and served during the war in the United States military telegraph corps.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT

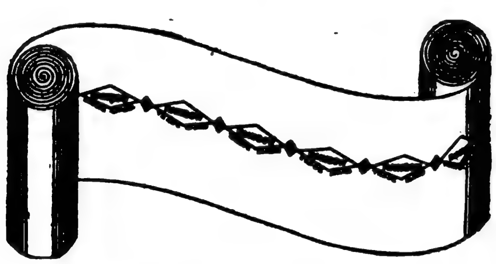
Mr. JUSTUS B. ENTZ,

Mr. Justus B. Entz, the electrical engineer, has opened an office for consultation purposes at room 135, Potter Building, N. Y. He is prepared to make examinations of and report upon new inventions and new enterprises, to issue specifications and supervise installations for light and power work. He is also ready to design and remodel dynamos and motors, and bring such apparatus up to the standard of modern practice. He will also make a specialty of designs and specifications for large accumulator plants with automatic switchboard controlling devices for same. Mr. Entz has had a ripe experience. He was chief electrician of the Edison Machine Works in 1889, and patented and designed, to Navy specifications, the first direct-connected multipolar dynamos in this country, for the cruisers "Philadelphia," "Baltimore," "San Francisco," "Charlestown," "Yorktown," etc. Later he was one of the incorporators of the Waddell-Entz Co., and the inventor and designer of the dynamos, motors and batteries of that company. For the past year he has been engineer with the Accumulatoren-Fabrik Aktien Gesellschaft, of Hagen, Germany, and has been studying storage battery work and their installation for central stations, isolated and train lighting. This brief record of Mr. Entz's busy career will give some idea of his ample qualifications for the work he is now undertaking.

RAINBOW PACKING OF THE PEERLESS RUBBER MFG. CO.

Among the many standard products of the Peerless Rubber Mfg. Co., 16 Warren street, New York, in the shape of mechanical rubber goods, none perhaps is better known than its celebrated "Rainbow" packing, of which an illustration is here given of a roll, in fac simile, bearing the familiar trademark. The well nigh incredible statement is made that over 4,000 tons of "Rainbow" have been sold in the last five years. It is made in rolls of about 200 pounds each, in sizes from 1/16 up to 1/2 inch.

This packing is especially adapted for very high pressure, and is not affected by any degree of steam heat. It will not harden under any degree of heat, or blow out under the highest pressure, and will make an air, steam, hot or cold water joint equally well.



ROLL OF "RAINBOW" PACKING.

It is not affected by oils, ammonia, liquors, steam, heat or alkalies. Unlike plumbago and usudurian, it will not harden or crack. Joints can be made and broken in one-eighth the time consumed with packings that harden, as a tool is not required to break or face off the joint.

In a letter of last April, D. W. Lanigan, the chief engineer of the enormous South Pump Water Works of Chicago, states that he has used "Rainbow" from the time it was first introduced, and upon joints exposed to steam at high pressure, and has found it exceptionally durable, reliable and economical. It is evident that such packing must be a notable element in the efficiency of electric light, railway and power plants, where it is always essential to get the utmost value out of the steam.

ORDERS FOR BALL ENGINES.

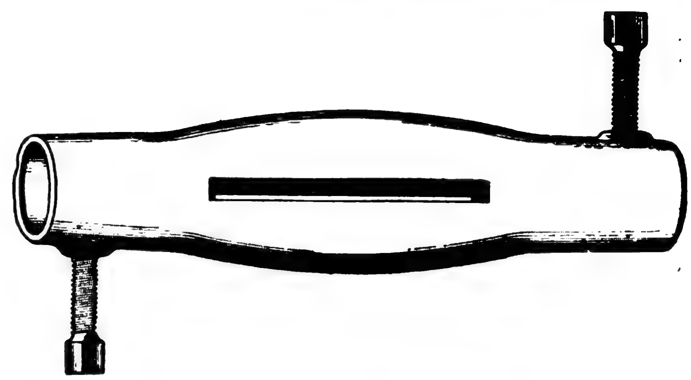
Crook, Horner & Co., Baltimore representatives of the Ball Engine Co., Erie, Pa., are installing three 175 H. P. Ball engines in the new Congressional Library Building, Washington. These engines are direct connected to Mather dynamos and the plant will be one of the most complete of its size in the country. The City of Galveston, Texas, is putting in an electric light plant in its municipal building. The engine is a "Ball" automatic and is direct connected to a Western Electric dynamo. An electric plant will be installed in the new Security Building, St. Louis. The Ball Engine Co. furnish the engines and the Western Electric Co. the dynamos.

ROEBLING'S "BALTIMORE" CONNECTOR FOR RAILWAY FEEDERS.

AN efficient connector for over head lines of heavy stranded weatherproof wire has been introduced recently by John A. Roebling's Sons Co. It is intended for use in joining concentric laid strands, and to replace the inefficient connectors heretofore employed for this purpose. Many of these are objectionable from their high first cost and the long time consumed in their application. These joints are unsightly when finished and suspended on a line and vitally defective in power to resist the strain due to stringing the strands.

The "Baltimore" connector is a hollow brass tube, thoroughly tinned, with a slot extending to within two inches of each end. The outside diameter at the centre of a connector for 500,000 C. M. is 1 5/8 inches, tapering to 1 1/4 inches at each end, with set screws in each end to hold the strand in place while solder is run in.

To apply the connector, the ends of the strand are stripped of insulation, the connector is slipped on, the ends of the strand brought together flush and the screws are set up tight. With an ordinary flat tool the wires in the strand are pressed out against the inner sides of the connector, and solder is then run into the joint. When covered with good friction tape the joint is barely perceivable at the elevation of an ordinary pole line.



THE BALTIMORE "CONNECTOR."

The Roebling Co. are also furnishing heavy feeder wire in extra long lengths. With wire in long lengths and the use of the Baltimore connectors, much time and labor is saved in the erection of a pole line.

WARREN WEBSTER & CO.'S RECENT ORDERS.

WARREN WEBSTER & Co., Camden, N. J., specialists in examining steam plants where increased economy in fuel is desired by utilizing waste exhaust steam, report considerable activity in their business. Among the recent orders for the Webster "Vacuum" feed water heater and purifier not reported since May, and in addition to numerous contracts for their vacuum system of steam heating, without back pressure upon the engine —Webster steam and oil separators—they mention:

Haldeman Paper Co. (2 heaters), Lockland, Ohio, 1,000 H. P.; Putnam Hooker & Co., Cincinnati, Ohio, 350 H. P.; Philadelphia Construction Co., Philadelphia, Pa., 500 H. P.; William Oswald, New Orleans, La., 75 H. P.; Dominion Oil Cloth Co., Canada, 150 H. P.; Harrisburg Fdy. & Mach. Co., Harrisburg, Pa., 300 H. P.; Temple Elec. Co., Temple, Texas, 150 H. P.; Buckner Orphans Home, Dallas, Texas, 100 H. P.; Philadelphia Construction Co., Philadelphia, Pa., 1,000 H. P.; Wilkesbarre & Wyoming Valley Traction Co., Wilkesbarre, Pa. (dupli.), 1,200 H. P.; Kittanning Elec. L., H. & P. Co., Kittanning, Pa., 250 H. P.; Morrison Plummer Co., Chicago, Ills., 200 H. P.; Diamond Match Co., Oshkosh, Wis., 500 H. P.; Enterprise Machine Co., Minneapolis, Minn., 50 H. P.; Chas. Roeser, Moundsville, W. Va., 150 H. P.; B. F. Gentsch & Sons, Buffalo, N. Y., 100 H. P.; Seltzer & Bro., Pottsville, Pa., 200 H. P.; H. Belfield & Co., Philadelphia, Pa., 200 H. P.; Deering Harvester Co., Chicago, 1,250 H. P.; Knox Hill Co., Warsaw, Ill., 100 H. P.; Mississippi Cotton Oil Co., Vadalia, La., 250 H. P.; Mississippi Cotton Oil Co., Jackson, Miss., 250 H. P.; Kaukauna Fibre Co., Kaukauna, Wis., 175 H. P.; Thilmany Paper Co., Kaukauna, Wis., 150 H. P.; Wire Goods Co., Worcester, Mass., 150 H. P.; Badger Paper Co., Kaukauna, Wis., 500 H. P.; J. J. Kenyon, Pawtucket, R. I., 300 H. P.; P. H. Potter, Springfield, Mass., 300 H. P.; Nonantum Worsted Co., Newton, Mass., 1,600 H. P.; Amory Mfg. Co., Manchester, N. H., 1,500 H. P.; Freeland Elec. L., H. & P. Co., Freeland, Pa., 320 H. P.; G. L. Brownell, Worcester, Mass., 100 H. P.; Boston Rubber Shoe Co., Malden, Mass., 600 H. P.; Jay Paper Co., Jay Bridge, Me., 500 H. P.; Henry Frey & Co., Boston, Mass., 250 H. P.; Uncas Paper Co., Norwich, Conn., 600 H. P.

MEDBERY WEATHERPROOF WALL SOCKET, FOR ILLUMINATED SIGNS.

The superiority of this socket, has been thoroughly demonstrated in its use for illuminated sign work, and it is popular for this purpose. There is no danger of fire from it, as all the connections are inside, and the composition is forced around them, under enormous pressure, making a socket of great strength and durability and one that is practically indestructible. Water cannot follow the wires and make a short circuit. The E. S. Greeley & Co., No. 5 and 7 Dey street, New York, are the New York agents, and keep a stock constantly on hand.

THE RUSSELL SWITCH.

The Electric Appliance Company, Chicago, are general selling agents for the Russell Automatic switch, having just closed exclusive arrangements. By means of this device a light or group of lights can be controlled independently from any number of points without any additional electric light wiring. The Russell switch is usually placed in the cutout box and a single circuit run to the light or group of lights to be controlled. From the switch, circuits of No. 18 wire are run to the points from which the lights are to be controlled where an ordinary gas key does the work. Pressing the white button, turns on the lights and pressing the black button, turns them off. The Russell devices are now approved by the National Board of Fire Underwriters and will undoubtedly meet a large sale.

TAKING 3,000 VOLTS.

FOREMAN F. E. Glover, of the Rochester, N. Y., Gas and Electric Co., was accidentally the recipient, some days ago, of a current of about 3,000 volts. It was about an hour before any signs of life could be detected by those who worked on him, using the d'Arsonval methods of resuscitation. Respiration began very slowly, but at last, although badly burned, he was revived and is now practically a well and sound man.

RECEIVER APPOINTED FOR THE SCHUYLER ELECTRIC CO

Ex-Congressman Lewis Sperry has been appointed receiver of the Schuyler Electric Manufacturing Company of Hartford, by Judge Thayer in the Superior Court. The Schuyler Electric Manufacturing Company sold its assets, including patents, to the Schuyler Electric Company of Middletown. The Supreme Court has decided that the sale was illegal, hence all the assets must be returned to the former company.

MR. A. L. REINMANN.

MR. A. L. REINMANN, well known to all old electricians, has accepted the position of Superintendent of the American Elecl. Manfg. Co., St. Louis; and his ability as a manufacturer of incandescent lamps will add to the already excellent quality of this Company's productions. Mr. Reinmann is well remembered as the former Superintendent of the Westinghouse lamp factory at Pittsburgh, and later of the Sawyer-Man Electric Co. in New York, until just before the works were closed by injunction; and the reputation established by these lamps is an evidence of his ability. He has also made many improvements in his processes, which have been adopted by the Company; and users of incandescent lamps may feel sure of being supplied with lamps that will be high grade. In these days when so many inferior goods are in the market, it will be gratifying to many to know that Mr. Reinmann's conscientious care and thorough knowledge will again be utilized in the manufacture of lamps, and the American Elecl. Manfg. Co. is to be heartily congratulated upon securing his services.

NEW ENGLAND NOTES.

THE EDDY ELECTRIC MANUFACTURING CO., of Windsor, Conn. have just completed arrangements by which they will hereafter be represented in New York by Messrs. H. B. Coho & Co., Mail & Express Building, who will for the present continue at the same address; in New England, by Messrs. G. M. Angier & Co., of 64 Federal street, Boston. Both these firms have for some time past been identified with the Mather Electric Co., and are well and most favorably known in the electrical trade. In addition Mr. S. N. Blake, of Elmira, N. Y., will represent the Eddy Co., in New York state, and altogether the new arrangement promises to be a very strong and successful one. Mr. F. C. Ross, who has represented the Eddy Co. in New York for some years will be connected with Messrs. H. B. Coho & Co. as salesman and so will still retain his interest in Eddy apparatus.

MR. ROBERT C. BROWN has resigned the position of electrical engineer to the Montreal Street Railway Co., to accept that of manager of the Halifax Electric Street Railway, Halifax, N. S. The latter company has a franchise that covers both street railway and lighting. Mr. Brown is at present on a visit to his home here, and will assume his duties at Halifax in a week or two.

NEW YORK NOTES.

THE C. J. FIELD CO., of New York, has been organized with a capital stock of $4,000 to conduct an electrical and mechanical consulting and engineering business. The incorporators and directors are C. J. Field, Frank Bourne and J. W. Gilmore.

THE HICKLEY ELECTRIC LAUNCH & MFG. CO., of Asbury Park, is experiencing a brisk demand for its 16-foot launches recently described in the ENGINEER, equipped with either storage or primary batteries. It is also putting its larger launches into commission for local traffic.

HAMMERSTEIN'S NEW OPERA HOUSE, the "Olympia" is to have a fine electrical plant. The building is situated at Broadway and Forty-fifth street. Hewes & Phillips engines are to be used, and a contract has been made for 600 H. P. of Campbell & Zell boilers, through the Eastern agents, H. D. Bayne & Co., 82 Nassau street.

MR. BENJAMIN E. DAVIS, of Pass & Seymour, of Syracuse, was a visitor at this office this week, and spoke encouragingly of the improved state of trade in his particular line. Mr. Davis is well known to the electrical trade, and has a large number of friends and acquaintances and as he travels nearly all the time, his opinion ought to be worth having.

AGREEABLE AND TIMELY PRESENTS.—The latest summer fad is to present your friend with a fan motor. Such a gift is highly welcome and begets a warmth of sentiment that is in exactly inverse ratio to the physical coolness created. The Interior Conduit and Insulation Co. report that their artistic fans are in brisk demand for this really ingenious and very useful method of giving vent to one's generous feelings. Verbum sap.

MR. HARRY M. SHAW, 136 Liberty street, has been appointed New York manager for H. T. Paiste Co. of Philadelphia, manufacturers of switches, sockets and cutouts. They have a large stock in New York to meet the demands of the trade. Orders for the Eureka Tempered Copper Company's specialties keep Mr. Shaw and his staff busy. His list of these supplies includes Tempered Copper segments, commutators, leaf and gauze brushes and Eureka dry batteries.

STANDARD AIR BRAKE CO. Mr. E. J. Wessels, general manager of the Standard Air Brake Co., leaves to-day (Wednesday) for Europe by the "Rhynland". His departure has already been announced in THE ELECTRICAL ENGINEER by a polyglot card. Preparatory to going abroad and getting on European soil, Mr. Wessels ran up to Canada last week, where he at once sold air brakes for 10 cars, to the Montreal Park and Island Railroad Co. This is the first sale in Canada, though not the first on foreign soil, and is simply another indication of the feeling in favor of better brakes.

WESTERN NOTES.

THE ELECTRIC APPLIANCE COMPANY are making special inducements on flexible switch cords for electric railways and others. They claim to have a superior article at a low price in their Paranite Flexible cable, and to carry one of the largest stocks in the West, enabling them to make prompt deliveries of large orders and special sizes.

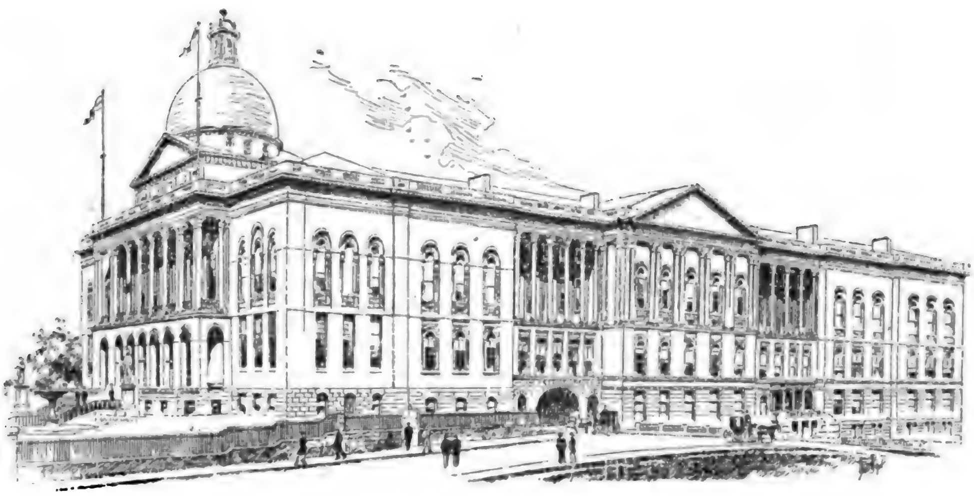
THE METROPOLITAN ELECTRIC COMPANY, 186-188 Fifth Avenue, Chicago, are not complaining about slow business; their sales having multiplied this year three times over the amount at the same period last year. They handle some of the best known specialties on the market; among them P. & B. goods, N. I. R. Rubber Wire, Solar Arc Lamps, Metropolitan Incandescent Lamps, the Portable Hose Bridge, etc.

Mr. W. P. SULLIVAN, who is well known in Chicago, and was formerly connected with the *Street Railway Gazette*, has been appointed Western Manager for THE ELECTRICAL ENGINEER, which asks for the continuance of courtesies and favors in his behalf. Mr. Carl Kammeyer, the efficient incumbent of the office for some time past has resigned to go into engineering work. He has been appointed electrical engineer of the Maywood, Ill., Electric Light Co., and superintendent and electrician of the Bullard Electric Co., of Chicago, which is manufacturing a high grade transformer.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

Vol. XX. JULY 10, 1895. No. 375.



The New State House of Massachusetts, Beacon Hill, Boston.

THE ELECTRICAL PLANT OF THE NEW STATE HOUSE OF MASSACHUSETTS.

BY

I.

EVERY visitor to Boston is familiar with the aspect of the old State House, whose gilded dome shines not only under the light of every day but in so many pages of history, poetry and fiction. The people are proud of it and its traditions, but proud as they may have been, they have not sought to deny that for many years past the accommodations of the seat of political power and legislation in the old Bay State have been sadly inadequate. The old building that crowns Beacon Hill has long been utterly unable to contain all the State Departments, and hence the movement to which is due the important changes of which this article will speak.

At first it was thought best to take down entirely the fabric of the old State House as designed and built in 1795-7 by Bulfinch, one of the foremost architects in the country in his day, and a Bostonian to boot. Respect for the past, and reverence for the memory of him who designed the far-famed gilded dome, that fetish of every dweller in Massachusetts, forbade any such act of vandalism. The old must not make way for the new; it must stand so long as it would, unsupported, and if the exigencies of modern growth demanded more room, why such improved quarters must assume the form of an annex or extension and be built up to and behind the Bulfinch pile. And thus it was that a compromise came to be effected between those who wanted an entirely new capitol and those who realized the necessity for something being done but insisted on the preservation of the historic edifice. So the undertaking took the form of a very large modern extension, now nearly complete, the finished details of which are a credit to the architect who prepared the plans, and to every firm and individual whose efforts have contributed to make this building one of the notable edifices of the country. It has recently been dedicated to the various uses for which it was erected, and all those whose public positions requires them to frequent it and those who come from afar to examine and admire this noble block, are unanimous in their praise of its comfort and convenience, its luxury and solidity. Massachusetts may well be proud of it; for it is just what was needed, and it is not, in any single detail, too good for the purposes for which it is now being used.

II.

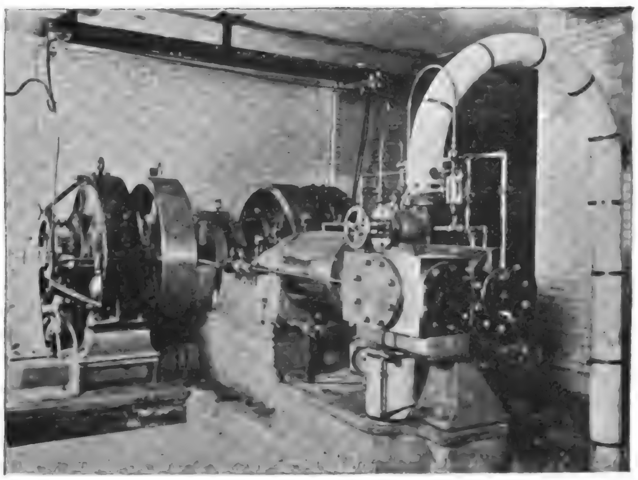
It were too long a story to go into full details of its construction and finish. That would be beyond the province of THE ELECTRICAL ENGINEER, so in this article an attempt will be made to describe the salient features only of the lighting, heating and ventilating plants which have been installed and are now running daily, giving unbounded satisfaction to all.

The electric lighting plant has an aggregate capacity of 8,000 incandescent lamps of 16 C. P. each. The lighting plant is installed in the basement and consists of three compound tandem non-condensing engines of the well known McIntosh-Seymour type. Each of these engines is of 180 H. P. capacity, having cylinders of 13 inches and 19 inches diameter each with 15 inches stroke. They are direct-connected each to two 50 K. W. machines built by the General Electric Co., running at 250 revolutions per minute. These engines were specially designed and finished for this plant, and were installed by Currier, Mayo & Co., Boston, N. E. agents of the McIntosh-Seymour Co. The same firm put in all the steam pipes, etc., etc., of the entire steam plant which in winter will furnish heat to the building. These engines were selected, after keen competition, and they are running both smoothly and noiselessly.

The steam for these engines is produced by two batteries of Babcock and Wilcox boilers, having an aggregate horse power of 830, although it is not all in use as yet. As we have already stated, the aggregate lighting capacity of the plant is 8,000 incandescent lamps of 16 C. P. each, current for which is furnished by six 50 K. W. multipolar iron clad generators, of the well known General Electric type.

III.

In the dynamo room is a large and handsome switchboard of polished white marble, twenty-two feet long and



DIRECT-CONNECTED DYNAMO PLANT, MASSACHUSETTS STATE HOUSE.

nine feet high. This board is covered with all the instruments necessary for operating and controlling the eight distinct circuits which run to every part of the immense building. Provision is made so that one or all of the circuits can be operated with current from their own plant, or can be separately and collectively connected with the Edison company's street circuit should there ever be occasion to do so. The circuits are installed in such manner, that the Senate Chamber, the Hall of Representatives, the various departmental offices, corridors and stairways can be illuminated separately and at will; while there is a distinct circuit for occasional lights here and there throughout the building, for the convenience of the night watchman.

In describing the switchboard a little more in detail it may be said that the main and circuit switches are all of the G. E. type single and double throw, two and three pole, finished in copper throughout and are very handsome. The measuring instruments consist of two main Weston ammeters which measure the total output of all the machines; also ammeter for each separate generator. The main ammeters have illuminated dials, the machine ammeters being of the round pattern isolated plant type.

There are also two Weston voltmeters with illuminated dials, and a portable voltmeter so connected by switch that the insulation of any generator or circuit can be tested out. Behind the switchboard are placed eight Carpenter enamel field rheostats, the handles of which are brought through to the front of the board. There is also a clock, together with steam and pressure gauges, etc.

Each engine is provided with a full height foundation box standing under the high pressure cyclinder and so forming a solid support for the cylinder while at the same time preventing all vibration, thus ensuring that there shall be no jar or noise when the engines are running either on full or light load. All the steam and exhaust pipes with one exception are placed underground, but are very easily accessible, and are covered throughout with non-conducting casing. The lighting throughout is done on the three wire system. The wire used was almost entirely the Okonite brand, there being nearly twenty-five miles of it in all, every yard of it laid in brass armored conduit of the Interior Conduit Co.'s make.

IV.

The various ventilating shafts in the walls, floors and ceilings have been availed of for running the circuits so that if it is ever required to take out a wire and put in another, such change can be easily effected without in the slighest way having to disturb plaster or board.

The dynamo and engine room is finished in white glazed brick and is about the largest and most convenient of its kind in the country. Even the boiler room is light, cool and cleanly, for the boilers are provided with the Roney mechanical stoker, fuel for feeding which is brought on miniature tram cars from the coal bunkers some distance away, while the ashes are removed from beneath the boilers by means of an underground tunnel, so that there is neither dust nor dirt ever to be found in the boiler room, while the occupation of the fireman is not nearly so dirty or so laborious as formerly.

The Star Brass Co. of Boston supplied all the water, steam and vacuum gauges which are placed on a handsome marble board as shown. The Mason Regulator Co. also furnished a number of its high class specialties.

Incidentally it may be stated that the Board of Commissioners appointed by the State to superintend the erection of this new building placed the entire work of designing and installing the electric light plant in the hands of the Massachusetts Electrical Engineering Co., which has installed many of the principal plants throughout New England. That Company prepared the specifications and plans and after the various contracts had been let supervised and thoroughly tested the entire work.

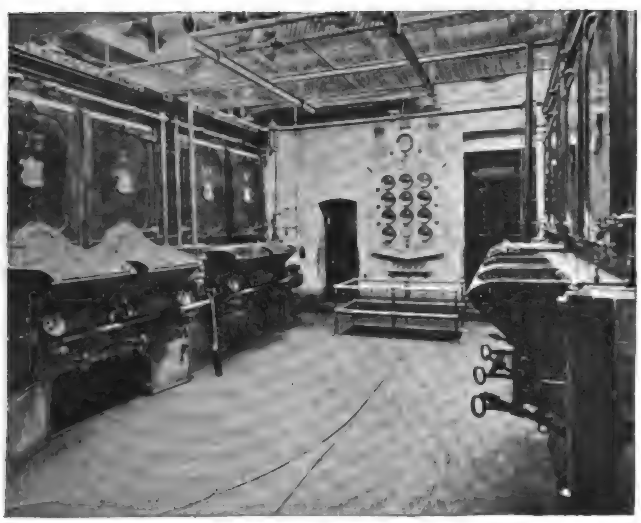
SWITCHBOARD AND GAUGES, MASSACHUSETTS STATE HOUSE.

V.

The electric light fixtures throughout the building call for comment, as they are, in general, of a very artistic character, the arrangement of the lights evidencing both artistic taste and sound judgment in securing good results. In the House of Representatives, in particular, the style

adopted is that of the Renaissance with most excellent results. In this room there is an enormous area to be illuminated. Here upward of eight hundred incandescent lamps have been installed in very effective groups and combinations. The hall is elliptical, and the direct light comes from one hundred and ninety lamps which shed their rays from the upper edge of the frieze, immediately at the base of the beautifully frescoed, vaulted ceiling, and in the centre of which is an immense stained glass sunlight. This corona of light is supplemented by lamps clustered together in richly cut opaque globes set on massive candelabra between the gallery columns and panel pilasters, the galleries extending half way around the ellipse.

These standards or candelabra are very rich designs. Each one rests upon a plinth of malachite. On this plinth rest four massive claws supporting a heavy metallic disc. From the centre of the disc rises a fluted shaft crowned with a handsome capital. Above the capital reach out eight arms at the ends of which are grouped thirty-six lights. There are eight of these groups. On the walls are massive bronze brackets each one supporting a number of lamps in richly chased globes. Similar taste and elegance is seen in the Senate Chamber as well as in the various rooms used by the legislators and the offices set



BOILER ROOM WITH MECHANICAL STOKERS.

apart for all the officials of the State. The fixtures throughout were supplied by the well-known Boston firm of McKenney and Waterbury, who have equipped many of the chief public buildings throughout New England.

As is the case in the erection of all modern buildings, the subject of heating and ventilating the new State House engaged the best thought and judgment of experts, and Professor S. H. Woodbridge, of the Mass. Institute of Technology, has succeeded admirably in these two important departments. He it was who designed most of the apparatus and who supervised its construction and installation.

VI.

The heating and ventilation is effected by means of two distinct sets of apparatus. The direct heating is by means of radiators placed under the windows in each room, and concealed by ornamental screens. These radiators are fed by the single-pipe system from main pipes hung in the roof space. Each radiator is automatically controlled by an electric thermostat, so that the steam is shut off when the temperature of the room reaches a certain point, say, 70 degrees.

The ventilation is by the "Plenum" system, two large fans, 12 and 10 feet in diameter respectively, installed in the basement and run by two 15 H. P. electric motors of the well known C. & C. type, supplying the fresh air, while the vitiated air is exhausted by means of one 7½ H. P., one 5 H. P. and one 3 H. P. C. & C. motors installed and connected with fans in the main roof of the building.

Ample provision has been made for warming the fresh air in winter time before it is distributed. This is accomplished by forcing the air through coils consisting of hundreds of pipes heated by steam, which is supplied from the boiler plant, the same boilers furnishing steam for heating the building throughout as well as for running the electric plants, pumps for elevators, etc., etc. The heating and ventilating plant was wholly built and installed by Mr. Albert B. Franklin, a well known engineer of Boston.

The elevator system was constructed by the Whittier Machine Co., Boston. The shafts are operated by hydraulic power throughout. The pumping apparatus is of the well known Worthington type, and consists of two compound duplex pumps, each of 3,000,000 gallons capacity, they being the largest pumps for elevator service now in use in New England. There are also three other pumps of the same make which are used for returning the water for condensation. Four Worthington water meters are in use, these measuring the water used in the entire building, and are of special design.

A very ingenious device which is operated by electricity is the dumb waiter or hoist in the State House Library. It was suggested by the librarian and built and installed by the Elektron Mfg. Co. This apparatus is used for transferring books from the different floors of the "stack room," and is controlled by a set of push buttons at each of the four landings. There are three buttons in each set—one to send the car up, one to send it down, and a third to stop it while running in either direction. A small Elektron motor furnishes the running power.

From the foregoing details and descriptions it will readily be appreciated that here as elsewhere, in the equipment of public buildings, where, presumably, there would seem to be least call for electrical or steam power plants, these two subtle forces have been made to play most important parts. The occupants of this extensive building go about their daily duties, winter and summer, enjoying the most agreeable comfort, subjected to no ill effects from over cold or over hot rooms; breathing every moment pure air which comes to them exactly as it will best conduce to health and pleasure.

ELECTROLYTICAL PROCESS OF BLEACHING.

In a recent review on progress in bleaching in *Lehne's Färberzeitung*, Dr. Kielmeyer mentions an electrolytical process invented by Dr. Karl Kellner. The necessary apparatus consists of a pair of rollers—the one iron, the other carbon—which, while rotating, are fed with an electric current by contact with wire brushes, and are thus converted into the two poles of a battery. The cotton cloth before passing these rollers is saturated with brine and runs in company with an endless felt blanket, also saturated with brine, which is next to the iron roller and receives the caustic soda formed, to deliver it further on into a tank filled with salt water. The chlorine liberated at the carbon roller accumulates in the cotton fabric. On issuing from between the rollers (whereof there may be several pairs) the cloth remains rolled up for some time before it is washed to prolong the bleaching process.

UNIVERSITY OF WISCONSIN.

The College of Mechanics and Engineering in the University of Wisconsin has published its announcement for 1895-96. The corps of instruction of the college shows an imposing front, and among the special lecturers appear such names as Alexander Graham Bell. The course at the collage is based on the idea of a thorough-going fundamental training in which the practical and the theoretical are equally combined. The Electrical course has been prepared with excellent judgment.

THE ACTION IN THE BOYNTON MULTIVOLT BATTERY.

BY

Wm. A. Anthony.

I notice in recent issues several communications in relation to the Boynton multivolt cell. Mr. Johonnot in the ENGINEER of June 12, attempts to give the theory of the battery and ignores entirely the fact that there are potential differences between the several carbons and also between the several zincs, as well as between zinc and carbon; and his theory, therefore, leads him to totally erroneous conclusions.

Prof. Carhart, in the same issue comes much nearer the truth, but in stating that "the most important leakage or waste current is between the zinc of cell 1 and the carbon of cell 3" (see accompanying Fig 1), he overlooks the E. M. F. of the cell. There is a difference of potential between the carbon of cell 1 and the zinc of cell 1, the

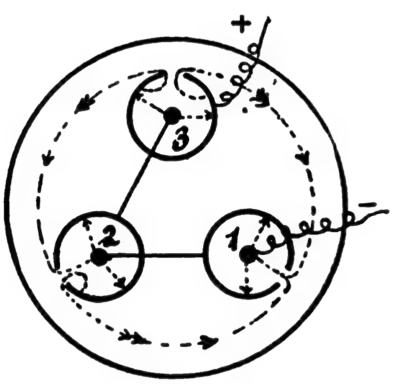


FIG. 1.

carbon being +, and yet, when the cell is in action, current flows through the liquid *from zinc to carbon* against the potential difference. There is, therefore, no greater *effective* potential difference between the zinc of cell 1 and the carbon of cell 3, than between the carbons of those two cells.

It is true that I did not allude to the fact that with a low external resistance the leakage would be small, but with a low external resistance this battery would be a very inefficient combination. The elements for such use should be joined in multiple and not in series. When

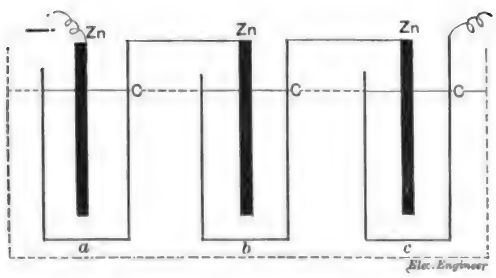


FIG. 2.

joined to produce a "multivolt" battery, its purpose would be to overcome a considerable resistance.

Now as to the leakage, let the connections between the different elements be broken and the resistance of the liquid from carbon to carbon, just as they stand, be measured. From the data given in the description of this battery in the issue of May 15, that the E. M. F. on open circuit was $5\frac{1}{4}$ volts and the current on short circuit 5 amperes, I deduce the resistance from carbon to carbon as equal to about 3 ohms.

Referring to my figure page 484 of May 29, which is reproduced here in Fig. 2, would it be considered good practice to connect the first and third carbons of a battery of three cells by a wire of 3 ohms resistance as shown by the dotted line, *a b* Fig. 3? Yet this is exactly what is done when the three elements are immersed in liquid in one cell. And what is gained by it? Nothing, except the facility in handling a gallon or two of liquid contained in one cell instead of three; and I venture to say,

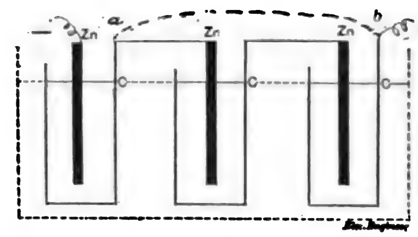


FIG. 3.

in consequence of the local actions, it will need to be replaced twice as often in the one cell.

I arrive at the resistance given above as follows. The E. M. F. of a zinc-carbon bichromate cell is given as more than 2 volts. The potential difference between the terminals of a battery of three well insulated cells in series would on open circuit be more than 6 volts, whereas the Boynton cell gives only $5\frac{1}{4}$ volts. This loss is due to the short circuiting effect of the leakage upon two of the cells, exactly as would occur if a conductor joined the points *a* and *b*, as shown by the dotted line in the figure. Assuming the full potential difference of 2 volts for the last cell, the two short circuited cells give only $3\frac{1}{4}$ instead of 4 volts, and this would be the case if the short circuit was a little less than four times the internal resistance of the two cells. It is stated that the battery on short circuit gives about 5 amperes; this means that its internal resistance is about 1 ohm, that is, $\frac{1}{3}$ ohm per element. Four times the resistance of two cells would be less than 3 ohms for the leakage path. This seems small if the outside of the carbons is perfectly insulated, but it cannot be far from the truth unless I have overestimated the E. M. F. of the element. If this leakage path has such a low resistance it means a leakage current of 1 ampere,—as large as the useful current that should be taken from a battery of such dimensions if it is to be used with any regard for efficiency.

LIGHT AND ELECTRIFICATION.

PROFESSOR LODGE contributes an interesting article to this month's *Science Progress* on photo-electric action, or the effect of light in facilitating the discharge of statically charged conductors. This is virtually a new branch of physics originating from an experiment of the celebrated Hertz, the influence of whose discoveries is now being felt in many departments of electrical science. Hertz observed that the sparking of an induction coil was facilitated when the light of another spark fell upon its secondary terminal. Further experiment showed that this effect was due to the ultra-violet rays, and that the neighborhood of the negative pole was the most sensitive part of the spark gap. It appeared from this that negative electricity would be more readily discharged than positive, and this was found as a rule to be the case. If ultra-violet light is allowed to fall upon a freshly scraped zinc disc forming the cap of a negatively charged electroscope, the charge will leak rapidly away. The most effective metals were found to be the alkalies, such as potassium and sodium, and the least effective, the noble metals, such as gold and silver. It was found, in fact, that if metals were arranged in the order of their facility for discharging negative electricity, they took the order of the voltaic series, a fact which indicated that electro-chemical action had something to do with the effect. Elster and Geitel, by the use of polarized light, showed that oscillations of light waves, perpendicular to the surface of the metal, produced a more rapid discharge than those parallel to it. The dissociation of molecules which is now considered to accompany the breaking down of electric strain, would appear from these experiments to be facilitated by light vibrations when applied in the direction in which the ions travel.—*London Electrical Review.*

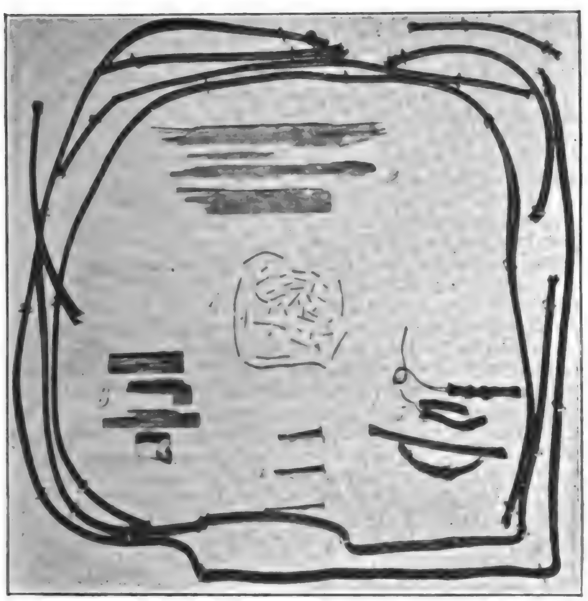
A SINGULAR EFFECT OF LIGHTNING STROKE IN CHICAGO.

BY

H. M. Stine

On Sept. 7, 1894, lightning struck the factory building of the Illinois Industrial Home for the Blind. But slight damage was done to the building, though some of the effects on the electric light wires were most singular.

The writer is indebted for the facts here noted, to Mr. Thomas Appleton, civil engineer, of Chicago, who was the Superintendent of Construction for the building. The Industrial Home is located on Douglas Boulevard, Chicago, the factory building being near the C. B. & Q. tracks. In his report to the Board of Trustees, Mr. Appleton states: "During the storm of last Friday night the chimney of the factory was struck by lightning, and about six feet of the south side of the chimney knocked down. The lightning also entered the room in the southeast corner of the upper floor, and destroyed some 50 feet of insulated wire, one drop cord and pendant, and the switch box. A large sliver was knocked off from the lower side of one of the roof beams, and it was a wonder the roof was not set on fire. Probably the whitewashing of the beam hindered the kindling of a fire at this point."



EFFECT OF LIGHTNING STROKE ON INTERIOR WIRING.

The roof beams were anchored by iron plates spiked onto the sides of the beams and extending through the wall with large cast iron washers outside the brick. The electric light wiring was open, cleated work, and was carried around the beams near the anchor plates. The lightning apparently struck an anchor plate and passed from this to the wiring. It knocked a near-by switch-box to pieces, breaking the porcelain fixtures and burning the screws. The upper screw of group 4 in the illustration shows the iron near the end melted out, leaving only the thread, like a spiral spring. Group 3, is a splintered oak cleat; while group 2 shows some slivers knocked off the beam.

The effect of the lightning on the wires is the singular part of the case. The outside diameter of the wire was $\frac{3}{16}$ inch, the conductor being No. 14 A. W. G. Around the conductor was a soft layer of white rubber; over this a layer of black rubber which was covered with the usual protecting layer of braid. The insulation was heavily coated with compound and finishing varnish. About ten feet of the insulation is shown in the illustration, for it is only a tube, the wire for the most part having disappeared, except between the letters B, C and D. Group 5 shows damaged pieces with the conductor present, though badly burned. The outside of the insulation in many places plainly shows the effect of heat; the varnish has disappeared and most of the compound melted out. At irregular intervals there are openings or ruptures. A few feet was split open and the rubber core found intact and only in a few places did it show traces of burning. There were scarcely any traces of copper markings that would indicate the wire had been vaporized. After the accident the conductor was found scattered about the floor. For the most part the pieces were from one-fourth inch to three-fourth inch in length and quite regular. Group 1 shows a number of these pieces. The wire seems to have been literally shot out from the insulation as from a gun. The uniformity of length of these pieces is significant. When a long piece of fuse wire is blown it invariably breaks into a number of pieces of quite uniform length. The two cases seem quite similar and indicate in a manner some form of rhythmic action. The faces of the ends in both cases are square and crystalline. This would suggest that the copper conductor was fused internally but cooled rapidly when exposed to the air. Only a few of the pieces are pitted and badly burned. An occasional piece of wire was found in the inner tube, but they were of uniform length with those that had been ejected.

AN IODINE VOLTAMETER.[1]

AFTER referring to the usual methods of determining the value of the small currents used in calibrating galvanometers and other apparatus for measuring small currents, and discussing the errors to which they are subject, the author gave his reasons for selecting iodine. He did this since with the exception of mercury in the mercurous state, iodine has the largest electro chemical equivalent, and, in addition, by titration with sodium thiosulphate it is possible to determine the quantity of iodine liberated with a greater accuracy than can be obtained by weighing a deposit of copper or silver with the balance. The solution employed in the voltameter contains 10 to 15 per cent. of zinc iodide. If care is taken to leave a small piece of metallic zinc in this solution no free iodine is liberated on keeping, unless the solution is exposed to a strong light for some time. The anode consists of a plate of platinum at the bottom of a tall and fairly narrow beaker. The wire leading the current to the anode is incased in a glass tube so that the iodine is only liberated at the bottom of the beaker, where, on account of its great density, it tends to collect. The cathode consists of an amalgamated zinc rod which, to prevent loose particles of zinc falling down into the iodine, is surrounded by a piece of filter paper or vegetable parchment. In an electrolysis lasting for as long as two hours none of the iodine is found to diffuse up to the part of the solution near the zinc cathode. Where, on account of the extreme feebleness of the current employed, it is necessary to allow the electrolysis to continue for longer and have two hours, a U-tube is used with two small plugs of asbestos at the bend, the anode being in one limb and the cathode in the other. With this form of voltameter, even after the current has flowed for several days, no signs of iodine have been found in the limb containing the cathode.

On account of the production of electric convection currents, the iodine voltameter does not seem to be quite so suitable for accurate measurements of strong currents. After the current is stopped the zinc electrode is immediately removed, the solution stirred, and the amount of iodine liberated determined by titration with sodium thiosulphate. The author finds that a convenient strength of the thiosulphate solution is one in which 1 cc. corresponds to the amount of iodine liberated by 5 coulombs of electricity. This solution contains 12 8375 grms. of pure recrystallized sodium thiosulphate per litre. It is possible to perform the titration to within 0.1 cc., which corresponds to 0.5 coulomb, or if the electrolysis lasted one hour, to $\frac{1}{7200}$ ampere. In a comparison made with a silver voltameter, the current as deduced from the silver was 0·0264 ampere, and that deduced from the iodine 0·0266. The author considers that part of the difference may be due to the effect of oxygen dissolved in the solution of silver nitrate.

EXPERIMENTS ON THE ELECTRIC DISCHARGE.

The London *Electrical Review* gives excellent reproductions of some of a remarkable series of photographs and dust figures produced by the action of very powerful electric discharges, which were exhibited on the lantern screen by Lord Armstrong at the last conversazione of the Royal Society. Most of the effects were obtained by the use of a large multiple Wimshurst machine, having 16 plates of 34 inches diameter, made by Newton & Co., and capable of giving a spark of about 17½ inches. The machine was fitted with two 10-gallon Leyden jars, as condensers, and was found perfectly adapted for the purpose of the experiments. The photographs were mostly obtained by the well-known method of causing the discharge to pass over the surface of a photographic plate with which the electrodes had been placed in contact. The dust figures were produced by discharging on glass or metal plates over which had been sifted various more or less non-conducting powders, such as calcined magnesia mixed with carbon in the form of lamp-black, tripoli powder, and hard carbon reduced to a fine powder. Many of the pictures were most suggestive, and it is not improbable that they may lead to advances in the knowledge of molecular physics, and of the true nature of electricity.

1. Abstract of a paper read before the Physical Society, May 10, by M. Kerroun.

ELECTRIC POWER IN FACTORIES AND MILLS.[1]

BY F. B. CROCKER, V. M. BENEDIKT AND A. F. ORMSBEE.

The application of electric power distribution to the operation of factories and mills, including the driving of the various machines and other apparatus, is the latest and one of the most important problems toward which attention is now being directed, the question being one of extreme prominence both from an economical as well as from an engineering standpoint.

In comparing two or more different systems of power distribution, the fundamental basis of comparison is generally that of dollars and cents. This is certainly correct, as far as it goes, but unless a very decided difference be found between the costs of running under the various systems, it may be found that other factors enter; factors which cannot be estimated in dollars and cents, namely, questions of desirability and convenience. Without considering any tests whatever, there are several exceedingly advantageous points in the use of motors in factories which are almost self-evident, such as: 1. Clear and unobstructed passages and head room, the latter facilitating the use of travelling cranes. 2. Ease of shifting the tools from place to place, possibly necessitating the placing of a starting box and the putting up of a little extra wire, as compared with the inconvenience and trouble of setting up and adjusting a line of shafting, hangers, belts, etc. 3. The economy due to the ability to run a single tool without necessarily starting the whole factory or at least a complete section. 4. The running expense is entirely stopped when the tool is shut down. 5. The absence of the drip of oil from overhead shafting. 6. The tools may be placed at any desired points almost regardless of the distance. 7. It is not necessary to arrange the tools parallel as in the mechanical system. 8. A wider range of speed is possible. 9. Less damage caused by a fuse blowing than by a belt slipping off in case of accident or excessive load.

Considerations like the above have great weight in deciding a question such as that under discussion, and there is no doubt whatever that in most cases they rise to such prominence that they warrant a complete change from the old system to the new, even though there is no gain in economy or increased output. In most cases, however, it has been conclusively shown that considerable saving and increase in production is obtained, one test showing a very considerable percentage of increase in the output. The partial, if not the complete, displacement of the old method by the new is only a question of time, and it was the appreciation of this fact that induced the authors to undertake the determination of the power actually required to run the various tools and machines as used in ordinary practice.

The authors then give a description of a series of practical tests carried out at the works of the Crocker-Wheeler Electric Co., at Ampere, N. J., and at those of the De La Vergne Refrigerating Machine Co., at Port Morris, N. Y. The results are given in the following table:—

TESTS AT THE CROCKER-WHEELER FACTORY.

No. of Test.	Size of Motor.	Number of tools driven by motor.	Average Amps.	Average H. P.	Remarks.
1	1.5 H. P.	1 boring machine,	8.3	1.23	
2	1. "	1 drill press.	2.85	.42	Less than ½ full load of motor.
3	1. "	1 " "	2.86	.42	
4	1. "	1 " "	1.9	.28	
5	1. "	1 punch press.	4.86	.71	
6	1. "	1 gang drill.	4.75	7	Drilling ¼ in. and ⅜ in. holes.
7	3. "	2 machines.	10 04	1.48	
8	1. "	6 "	5.86	.86	All small machines.
9	3. "	7 "	13.36	1.97	
10	3. "	8 "	9.92	1.46	
11	7.5 "	2 "	33.1	4.87	Required 2.3 H. P. to run shafting only.
12	10. "	20 "		4.78	Tested by watt meter.
13	3. "	5 "	7.0	1.08	
14	3. "	1 engine lathe.	11.4	1.68	Light cut taken by tool.

TESTS AT THE DE LA VERGNE WORKS.

1	15. H. P.	1 planer.	20.08	5.11	Planer 10 in. x 9 in. x 22 in. Voltage 190.
2	5. "	1 drill press.	4.07	1.23	⅞ in. drill. Voltage 215.
3	10. "	1 boring tool.	14.47	4.17	Voltage 215.

The results obtained in these tests show that the power required to drive machine tools has been considerably overestimated, for it will be noted that with a large majority of the tools tested, the motor was not more than one-half loaded, and in these cases it was seldom that the load equalled the full power of the motor, even for an instant. In the case of the large planer, although the motor was overloaded 50 per cent. upon reversal of the bed, the average load was only one-third of the rated full load. With this machine, however, when the piece of work is very short, necessitating more rapid reversals, the average load will be much nearer the most economical output of the motor.

The question of running machine tools by individual motors or grouping a number of machines together and driving them by one motor, does not seem to allow of a general solution. It would not be advisable, for example, to use the individual system where there are a number of small tools, each one of which requires only a small fraction of a horse-power. On the other hand if we have a large tool that requires considerable power, it would seem to be far more economical to run it by a single motor, using as little belting and shafting as possible.

The introduction of the electric system of distribution of power in the cotton industries of New England is now fairly begun. Although there are no large mills driven entirely by this system, a number of them have an electric plant and certain sections of the mill are driven by motors. An electric plant was installed four or five years ago in the works of the Silver Spring Bleaching and Dyeing Co., at Providence, R. I., but it was intended chiefly for lighting. But motors were placed in the carpenter and repair shops, and several other places, until at present there are about 100 H. P. of motors installed in eight units.

A visit was made to the works of the Donnell Manufacturing Company, at Pawtucket, R. I., where a very fine electric plant has very recently been installed to drive the calico printing machines. The problem of running this class of machinery by electric motors has been a very difficult one to solve, for the motor must be capable of running at a number of different speeds and running constantly at any given speed with a variable load. In this case it has been solved by the use of a modification of the Leonard system of motor regulation. The outfit for each printing machine consists of a motor and a dynamo of the same size, the field rheostat of the dynamo being placed alongside the printing machine. The speed of the motor is thus changed by varying the voltage of the particular dynamo which supplies it with currents.

This plant has been completed but a short time, and it was not possible to obtain any accurate figures showing the power used by the motors under various conditions of speed and load. Formerly the machines were run by individual engines and much difficulty was experienced in starting them, as the pressure of the printing rolls against the cloth is so great. With electric motors this difficulty is overcome, as the motors will stand a very heavy overload for a short time, and the starting torque is very great. The great advantage of the electric system as here used is not so much in the saving of power as in the convenience to the workmen, and hence the increased production.

Although this plant has been in operation only a short time, it is claimed by those in control that the production is materially increased. In a paper by Mr. S. B. Paine in *Power*, June, 1895, he states that the increase in the production amounted to more than 25 per cent., and that the quantity of "seconds" (inferior product) was also considerably reduced. This is very important as the men in charge of printing machines are skilled workmen of the higher order and a small saving in wages for a given production is of more value than a considerable saving of power.

A visit to Baltic and Taftville was also made to see the practical working of the well-known power transmission plant between these places. At Taftville, where the Ponemah mills are located, there is not sufficient water power to drive all the machinery, so an electric plant was installed at Baltic, 4¼ miles up the river where a dam had been built, giving an available head of 34 feet.[2]

First Cost.—Practically the only objection which can be urged against the electric system is the fact that the first cost of installation is greater than with ordinary belting and shafting, but even this is questionable since the authors know of cases in which the estimated total cost of installing the necessary belting and shafting was actually greater than the equivalent electric motor outfit. The electric system would be cheaper for example in the case of very long or scattered buildings or those containing many stories or rooms, in any of which cases the belting and shafting required would be very complicated and expensive. The use of belting and shafting requires a much stronger and more expensive roof or ceiling than the electric system.

Saving of Power.—It might seem that the electric system would actually consume more power than the ordinary plan since it involves two transformations of energy. In most cases, however, if the power has to be distributed to a number of machines, particularly if they are located at any distance from the engine, the loss of power is less with electric transmission. This is explained by the high efficiency of the dynamo and motor compared with the low efficiency of belt transmission as ordinarily practiced, involving as it often does very imperfect alignment and lubrication of the shafting. Perhaps the greatest saving, however, of the electric system is due to the fact that the consumption of energy entirely ceases when the tool stops. This

1. Abstract of a paper read before the Amer. Inst. of Elec. Engrs., Niagara Falls, June 26-30, 1895.

2. See illustrated description of this plant, THE ELECTRICAL ENGINEER, May 2, 1894.

stoppage in the case of the busiest tools amounts to at least 25 per cent. of the nominal working hours throughout the year and with large or special tools which are not used so steadily, the stoppage is often as high as 50 to 75 per cent. since there are many whole days when they are not used at all.

Idleness due to strikes as well as to slack times must also be considered and would usually amount to quite a large percentage in ten years for example. This assumes, of course, that a portion of the shop is running, which is usually the case even under such conditions. In short with the mechanical system there is an enormous amount of shafting, idle pulleys and belting which runs for long periods of time doing little or no useful work, but consuming considerable power.

Wherever electric motors can be substituted for a number of small engines scattered about, the saving in power is very great not only because of the low efficiency of small steam engines, but also by the avoidance of condensation in long steam pipes.

Increased Output.—This is, perhaps, the most important advantage gained by the electric system since after all the cost of power is a very small item, being, according to Mr. Richmond,[1] only about 1 per cent. of the wages paid in average machine shop practice. This increased output is secured by the greater convenience and promptness in starting and stopping as well as in regulating the speed of the machinery. The workman can, for example, temporarily increase the speed when the conditions are favorable, thereby saving considerable time.

Flexibility.—The great convenience of moving the tools and placing them in any desired position is another great advantage of the new system. The great adaptability of this system is particularly well shown in the case of a factory which was almost completely destroyed by fire, nevertheless a few uninjured tools in a remote end of the building were operated successfully by means of electric motors within two days after the fire.

Speed Regulation.—The ordinary type of motor used in factories is the plain shunt wound machine fed with constant potential current. The motor is started and varied in speed by means of a rheostat in the armature circuit. This simple arrangement answers very well in most cases, but for variable speed between wide limits a series wound motor controlled by a rheostat as in electric railway practice may be preferable. In other cases some special method of regulation such as the Leonard system, or the "boost and retard" plan, may be adopted.

THE COST OF STEAM POWER.[2]—II.

BY CHAS. E. EMERY, PH. D.

Previous articles of the writer on this subject dealt with the problem as it practically presented itself at the several times. The first article in 1883[3] referred particularly to results which had been obtained in a number of typical cotton mills by the use of the ordinary condensing engines in vogue at the time. A more recent article in 1893[4] discussed the question of the cost of steam power in 500 H. P. units or multiples of the same developed in different kinds of engines, including the more modern triple compound engines. The first paper was based on actual conditions, the second on assumed conditions, the best experimental results being considered, but afterward modified by judgment so as to give a final result which would approximate the conditions of ordinary average working. In a later and more general article published in 1895[5] the method employed to increase experimental results to an approximately practical basis was outlined, but otherwise the inquiry was extended little or no further than before.

In connection with the proposed supply of power in large units from Niagara Falls and other undertakings of a similar character, the question naturally arises: What would be the cost of steam power if also supplied in large units and generated with modern machinery of the most approved type? The question would be a simple one if it involved only the amount of coal consumed at a definite price, and the labor required to handle the coal and attend to the machinery. It is very common to compare the value of two engines simply by the relative amount of coal consumed, assuming that other costs incident to the development of the same power will be the same in all cases. Even if the assumption be substantially correct it has a more important bearing on the result than appears at first sight. The cost of coal is for ordinary engines of moderate size only about one-third of the total cost of steam power, so, if the other costs remain nearly constant, moderate savings in the cost of coal will not proportionally decrease the cost of the power.

The size of the units is limited by the conditions. If 20,000 H. P. as a maximum were to be delivered, two units of 10,000 H. P. each would do the work, but evidently the spare engine would require also to be 10,000 H. P. and this would involve too large an amount of capital in spare machinery. At Niagara Falls five connected turbines and dynamos of 5,000 H. P. each are being erected in a preliminary plant so that only 20,000 H. P. maximum can be delivered if one unit is held in reserve.

The average cost per H. P. when the load is variable is considerably greater than if the power be furnished continuously. It is desirable at the outset, however, to ascertain what steam power will cost under the most advantageous conditions as to demand, and we therefore submit a preliminary estimate based on the assumption that 20,000 H. P. can be sold for every hour in the year.

TABLE I.

SHOWING COST OF STEAM POWER ON BASIS OF GENERATING 20,000 H. P. CONTINUOUSLY EVERY HOUR IN THE YEAR.

			Per Cent. of Total Cost.
	Yearly cost of coal for 20,000 net H. P. operated continuously every hour in the year, based on a consumption of 1.25 pound of coal per indicated H. P. per hour. Cost of coal assumed at one mil per pound, or $2.24 per ton.		
1.	Engine efficiency assumed at 92.3 per cent.	$237,950	43.4
2.	Estimated cost of labor	60,444	11.1
3.	Estimated cost of supplies and regular repairs	105,190	19 2
4.	Estimated interest, insurance, taxes and cost of renewals	144,000	26.3
5.	Total	$546,814	100.0
	Which divided by 20,000 gives the following:		
6.	Cost of steam power per H. P. per year, on a basis of 20,000 H. P. delivered every hour in the year	$27.34	
7.	Cost of steam power per H. P. per year on above basis, if 5 per cent. of the original cost of plant be charged for dividends, and $1.00 per H. P. added for general business expenses, 27.34 + 3.60 + 1.00 =	31.94	
8.	Cost of steam power per H. P. per year on above basis, if 10 per cent. of the original cost of plant be charged for dividends, and $1.00 per H. P. added for general business expenses, 27.34 + 7.20 + 1.00 =	35.54	

This cost is lower than it is probable any plant can be operated under commercial conditions. This price is somewhat higher than those given in the papers previously mentioned, simply because operation is supposed to be continued every hour in the year.

We, therefore, assume that the power will be produced regularly for 1¼ pounds of coal per indicated H. P. per hour which would be obtained with engines requiring 12½ pounds of feed water per H. P. if the boilers evaporated 10 pounds of water per pound of coal, or if the boilers evaporated 9.6 pounds of water per pound of coal and the engines only required 12 pounds of water per H. P. per hour. For permanent work of the kind assumed, engines of comparatively slow speed should be selected and, although some of the work might be directly connected, part of it at least would necessarily be operated by some method of transmission. The frictional losses of the engines and the more important features of transmissiom to the work done have been assumed at 7.69 per cent., so that the amount of coal per indicated H. P. above assumed must be increased by $\frac{1}{13}$ to give the coal per net H. P.

The best quality of coal will cost but little over $2 per ton if purchased in large quantities, though this price must be increased on the seaboard fully 75 cents, and for ordinary consumers, of course much more. The price upon which comparison has been made is one mil per pound or $2.24 per ton, to include the cost of delivery directly in front of the boilers. The cost in line 1, Table I, is derived simply by multiplying the net power, 20,000, by 1¼, the coal per indicated H. P. adding $\frac{1}{13}$ to allow for friction, and multiplying the result by 8,760, the number of hours in the year, and $0.001, the price per pound.

The total cost of such a plant cannot be determined accurately in advance. The present prices for steam machinery are very low and it might be possible to buy engines of the best type with necessary boilers, ready for erection for $30 per H. P. To this price, however, must be added the cost of the land upon which the plant is to be erected, the cost of foundations, of erection, of the buildings, of the chimney, the pipe connections, the general means of transmission, and the multitude of minor details required for fitting up such a place ready for use. The probable cost has been fixed at $64 per H. P. and as at least ⅛ surplus power will be put in the station there will be required a steam plant of 22,500 H. P. which at $64 will cost complete $1,440,000, 10 per cent. of which as required above is written in line 4.

Referring to line 6, we find that the "Cost of steam power per H. P. per year on the basis of 20,000 H. P. delivered every hour in the year" is $27.34. The price at which this power can be sold to consumers will depend upon the way the company furnishing the power is organized. The interest on the cost is already provided for in line 4, so the net cost given, viz.: $27.34, would be that chargeable to power if the same company that built the works used the power, or if an association of individuals should build the plant and simply charge themselves with its cost.

If, however, a private company with ample means should build the plant on a cash basis and wish to sell power and realize a return of 5 per cent. on first cost, independent of interest on the money invested, the modified cost would be $27.34 plus 5 per cent. of 64 × 1⅛ = $72, viz.: $3.60, to which should be added, say $1 per H. P. for general business expenses, making the total charge $31.94 shown in line 7, Table I., the same method being used in reference to similar lines in Tables II. and III.

1. *Engineering Magazine*, January, 1895.
2. Abstract of a paper read before the Amer. Inst. of Elec. Engrs., Niagara Falls, June 26, 1895.
3. Trans. Am. Soc. C. E. vol. xii., p. 425, Nov. 1883.
4. Trans. Am. Inst. El. Engrs., vol. x., p. 119, March, 1893.
5. *Engineering Magazine*, vol. viii, p. 796, Feb. 1895.

If, however, the promoters desired 10 per cent. profit on original cost or a proportionally less percentage on stocks and bonds issued in excess of first cost, the modified cost per H. P. per year would be $27.34 plus 10 per cent. of $72, viz.: $7.20, to which adding $1 per H. P. as before for general expenses gives as the total charge under these conditions $35.54, shown in line 8, Table I., the method applying to Tables II. and III.

We are now prepared to ascertain the variations in result which would be produced if the power were considered variable. For this purpose let us assume there will be sold :

	Daily H. P. Hours.
1. 20,000 H. P., 10 hours per day	200,000
2. 12,000 H. P., 10 hours per day	120,000
3. 5,000 H. P., 4 hours per day	20,000
4. Total daily H. P. hours	364,000

which would probably be required on, say, 309 working days in the year.

5. Total H. P hours, 309 days	105,060,000
Then if 5,000 H P. were required for the remaining 56 days in the year:	
6. Total H. P. hours 56 days of 24 hours, 5,000 H. P	6,720,000
7. Total H. P. hours per year	111,780,000
Average H. P. per hour during the year:	
8. Previous result + 8760 =	12,760 H. P.

The average H. P. is therefore 63.80 per cent. of the maximum. This percentage is frequently termed the "power factor," and is rather higher than has been found in practical cases heretofore. An estimate of the cost on this basis is given in Table II.

TABLE II.

SHOWING THE COST OF STEAM POWER ON BASIS OF GENERATING 20,000 H. P. MAXIMUM AND AN AVERAGE OF 12,760 H. P. FOR EVERY DAY IN THE YEAR.

		Per cent. of total cost.
1. Yearly cost of coal	$157,644	37.3
2. Estimated cost of labor	47,652	11.3
3. Estimated cost of supplies and regular repairs	73,584	17 4
4. Estimated interest, insurance, taxes and cost of renewals.	144,000	34.0
5. Total	$422,880	100.0
Which divided by 12,760, the average H. P., gives the following:		
6. Cost of steam power per H P. per year on basis of delivering 20,000 H. P. maximum and an average of 12,760 H P. for every day in the year		$33.14
7. Cost of steam power per H. P. per year on above basis if 5 per cent. of the original cost of plant be charged for dividends and $1 per H. P. added for general expenses, 33.14 + 3.60 + 1.00 =		$37.74
8. Cost of steam power per H. P. per year on above basis if 10 per cent. of the original cost of plant be charged for dividends and $1 per H. P. added for general expenses, 33.14 + 7.20 + 1.00 =		$41.34

The cost of coal is made up as follows: By reference to the above it will be seen that 15,000 H. P. of boilers out of 20,000 must be shut down daily for periods varying with the demand, and it is considered that it will require an amount of coal equal at least to the average consumption for one hour during regular operation, to maintain banked fires, overcome radiation and bring the fires to average working condition when they are again put in operation. The total daily H. P. hours in line 4 is therefore increased 15,000 and multiplied by 309; the horse-power hours for the 56 holidays, line 6, are then added to the same; the sum multiplied by 1.25 pounds of coal per H. P. and by one mil per pound and one-twelfth added to the whole for friction, which gives the result written in line 1, Table II.

A large proportion of the power in manufacturing establishments is used only 10 hours per day, so this investigation would not be complete if it did not include a presentation of the cost of steam power generated with large units for 10 hours per day. Such an estimate is made in Table III.

TABLE III.

SHOWING THE COST OF STEAM POWER ON THE BASIS OF GENERATING 20,000 H. P. CONTINUOUSLY FOR 10 HOURS PER DAY FOR 309 DAYS IN THE YEAR.

		Per cent. of total cost.
1. Yearly cost of coal	$92,056	30.6
2. Estimated cost of labor	27,198	9.1
3. Estimated cost of supplies and regular repairs	37,080	12 3
4. Estimated interest, insurance, taxes, and cost of renewal	144 000	48 0
5. Total	$300,334	100.0
Which divided by 20,000 gives the following:		
6. Cost of steam power per H. P. per year on the basis of delivering 20,000 H. P. continuously for 10 hours per day for 309 days in the year.	15.17	
7. Cost of steam power per H. P. on above basis if 5 per cent. of the original cost of plant be charged for dividends and $0.75 per H. P. added for general business expenses 15 17 + 3 90 = 18.77; 18 77 + 0.75 =	19.52	
8. Cost of steam power per H. P. per year on above basis if 10 per cent. of the original cost of plant be charged for dividends, and $0.75 per H. P. added for general business expenses. 15.17 + 7.20 = 22.37; 22.37 + .75 =	23.12	

The quantities in the paper above mentioned were augmented here and there so as by judgment to try and approximate the various losses incident to average practice, though insufficiently to show the results of such practice in some locations. The prices herein given are as low as it would be safe to expect with very careful management of a very large plant. The comparatively small difference in result is due to the influence of the constant cost shown in line 4 of the several tables. It forms 26.4 per cent. of the total cost for 20,000 H. P. every hour in the year, Table I.; 34 per cent. for variable power, 20,000 H. P. maximum, 12,760 H. P. average day and night, and rises to 48 per cent. for 20,000 H. P. during 10 hours of the ordinary working days in a year. The cost of coal is respectively 43.4 per cent. 37.3 per cent. and 30.6 per cent. of the total cost for the same three conditions. The fixed charges also increase greatly the cost of water power, as the writer has had occasion to call to the attention of parties engaged in these large hydraulic enterprises.

It should be borne in mind that if water power or power derived from water be sold on a 24 hour basis, but can only be utilized during 10 hours per day, the cost of the water power direct or derived should be compared, not with the cost of steam power on a 24 hour basis in Table I. or II., but with that of steam power on a 10 hour basis in Table III.

It should also be borne in mind that all these estimates provide for fixed expenses, such as interest, insurance, taxes and cost of renewal, and that in comparing the prices above given with the cost of water power, similar fixed expenses should be added to the price of such power, based on the cost to the consumer of installing the water power or the mechanism through which the power is derived. For instance, manufacturers located on the canals of large water power companies necessarily build their own head and tail races and wheel-pits and install the gates, screens, turbines and means of transmission for utilizing the power. This when well done in many locations costs as much as to install a steam plant, so the fixed annual charges for this item alone would be $5.00 to $7.00 per H. P., which together with cost of labor and supplies, must be added to the cost to be paid for the water power in order to compare with the cost of steam power as presented in the tables of the writer.

When power is electrically transmitted, the consumer is generally required to pay for the electric motor, the general means of transmission therefrom and some incidentals. The cost of this work, together with the portion of the building and even of the real estate occupied should be considered in the same way as has been done above, and at least 10 per cent. of such cost, together with actual costs of labor and supplies, added to the tendered price of net power delivered, in order to compare the cost of power obtained in this way with the cost of steam power shown in the various papers of the writer, which are written on the basis that a manufacturer should receive a profit on the money expended in plant as well as that expended in his business. If interest is left out in one case it should be in the other and it is already included in the tables.

The last column of the several tables furnishes a ready means of eliminating either of the items of cost desired. For instance, in Table III., which is on a 10-hour basis, we find in line 4 that the "estimated interest, taxes and cost of renewal" is 48 per cent. of the total cost, which cost to the parties using the power is in such table $15.17 per year, line 6. The cost of steam power per H. P. per year from large units for 10 hours per day, without considering the above items, is therefore only 0.52 x $15.17 = ..$7.89 which is the cost to be compared with the price of power from an external source when the items above referred to are excluded in each case as they are in the popular discussion of the subjects. The similar cost from the estimate in the Transactions of American Institute of Electrical Engineers above referred to is $22.31, less (3.31 + 7.17) = 22.31 — 10.48 = ..$11.83. The difference, $3.94 is due principally to the relative sizes of plants considered in the two cases.

THE E. M. F. OF ALLOYS.

THE December issue of the *Journal* of the Chemical Society contained the paper by Mr. A. P. Laurie on the electromotive force of alloys in a voltaic cell. This interesting paper was suggested to him by a study of Matthiessen's well-known paper in an early number of the *Philosophical Transactions*, 150. The results of the determinations of the electromotive force of 16 of the 19 alloys referred to by Matthiessen are here given, and it is interesting to observe that the latter's conclusions are entirely confirmed, namely, that only one compound exists amongst the 16—the tin-gold alloy. The others were bismuth-tin, bismuth, lead, bismuth-gold, bismuth-silver, gold-silver, antimony-lead-cadmium-zinc, antimony-tin, lead-gold, lead-silver, lead-tin, lead-zinc, lead-cadmium, and cadmium-tin. The method employed in examining these alloys was to prepare small samples from approximately pure metals, and by means of a Thomson quadrant electrometer, to test the E. M. F. in voltaic cells of various construction against that of a standard Daniell.

FOSTORIA, O.—The Citizen's Telephone & Message Co. has been formed; capital $15,000.

COMPOUNDING DYNAMOS FOR ARMATURE REACTION.[1]

BY ELIHU THOMSON.

Considerable attention has recently been drawn to the subject of means for counter-balancing or preventing armature reaction in dynamo-generators or motors The valuable paper of Messrs. H. J. Ryan and Milton F. Thompson, read before the Institute at its meeting on March 20th, called forth considerable discussion as to the actual utility or need of added devices, which undoubtedly render a machine more complex, but which can certainly be made to obliterate armature reaction or overcome its effects. The opinion which seems to prevail amongst engineers is that by taking advantage of the best principles of design, the output of our machines is not limited by armature reaction, but rather by heating, or the capacity to diffuse that heat which is sure to be produced during operation.

The subject itself has been worked upon by the writer as far back as 1879. At first a peculiar disposition of the field coils and pole pieces was selected, unfavorable to armature reactions, and later in a patent applied for by the writer in the year 1885, the series coil of a compound-wound machine was so disposed as to add, under load, a magneto-motive force to the field in the region of armature opposition, and as a consequence to diminish somewhat the magneto-motive force of the field where the reaction of the armature was positive, or assisting.

In the present paper, however, the writer discusses a different type of dynamo, worked upon by him some three or more years ago, in which there is no series winding whatever, though the machine is in effect compounded, or over-compounded at will. The present paper is not intended to advocate the disposition described as a desirable commercial structure, or even as one which will be likely to come into practical use on any scale. The machine is, however, interesting as bringing out forcibly the capability of the armature current to neutralize its own effects in a proper structure and maintain, or even increase, the potential at the brushes under heavy loads. In fact the current in the armature in the type of machine herein treated, is made to react under load to magnetize a portion of the field structure which at no load is neutral or nearly so. The reaction may thus be made to give rise to a magnetic flux sufficient or more than sufficient to compensate for its effect in diminishing the flux of the other or excited portion. The result is accomplished by dividing each field pole into a portion which is left unwound and a portion which is wound and excited in shunt or separately. At no load only, the wound polar portions act to generate the open circuit E. M. F. As the load is put on, the unwound or dead poles become active in consequence of a magnetic flux developed in them by the armature currents themselves, that is, in consequence of the M. M. F. generated by the current in the winding of the armature itself. The disposition of the poles in a bipolar structure would be represented by Fig. 1, where A A are the excited poles, or wound field cores, under the fringe of which commutation is effected, while D D are the "dead" poles or sections of polar surface unenergized at no load. A dotted line a a may pass through the neutral or non-polar portion of the armature iron, threaded by all field lines on one side, while the lines b b may indicate the diameter of commutation on which the brushes rest. In such a structure by choosing the position and spread of the "dead" poles in relation to that of the wound or excited polar portions, and adjusting the E. M. F. of the initial field relatively to the turns on the armature and the speed of driving, the effect of compounding or over-compounding may easily be obtained. The "dead poles" may be made adjustable in position so as to vary the effective M. M. F. of the armature upon them and various changes in relations of the parts are conceivable. In Figs. 2 and 3, an attempt has been made to represent the magnetic flux under no load and under load, respectively.

Fig. 4 is from a photograph of the dynamo constructed in accordance with the principle under discussion. It is multipolar, having four wound poles and four dead poles alternating in position around the armature. The latter is of standard iron projection type, being in fact identical in construction and dimensions with the armatures used about three years ago in regular four-pole dynamos of the marine type of the Thomson-Houston Electric Co.

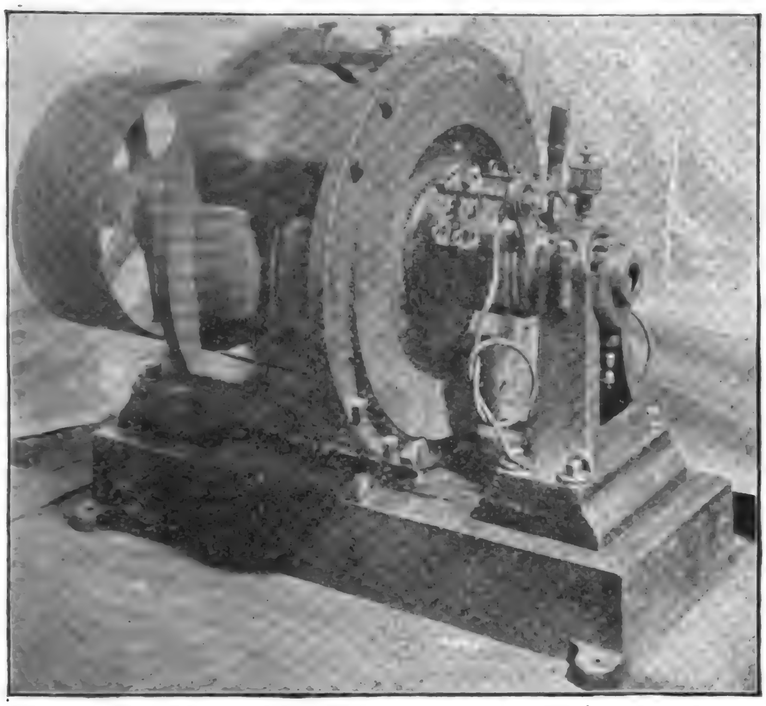


FIG. 4.

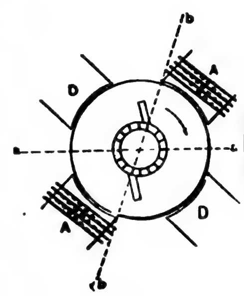


FIG. 1.

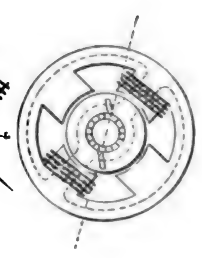


FIG. 2.

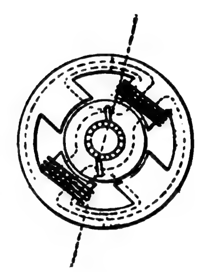


FIG. 3.

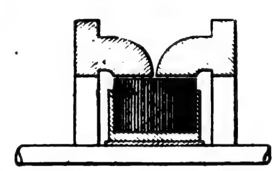


FIG. 5.

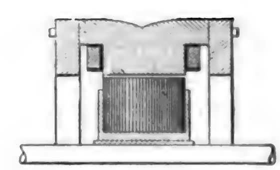


FIG. 6.

The principal data of the armature construction are as follows:

Diameter over all	17	inches
Length (laminations)	8	"
Radial depth of laminations	4	"
No. of projections	87	"
Width of slots	.34	inch.
Depth of slots	.75	"

The armature is series drum-wound and has two conductors in each slot. The commutator has 87 segments. The new field system was constructed of two rings of cast open hearth steel having heavy lugs, four in number, projecting laterally from each ring on one side, and forming the dead poles when assembled in the machine. Fig. 5 is a section of the field in a plane passing through the dead poles and axis of the armature, and Fig. 6 is a similar section through the active wound poles.

The normal current of full load for the armature as constructed and used in the regular multipolar field was 140 amperes, and it was found that as the load was increased steadily during a run, the potential was not only maintained but increased with each increment of load, thus showing an over-compounding effect. This effect was less marked when the initial excitation was weak; as when less than three amperes traversed the field coils. The over-compounding under load was, of course, still more increased when the field coils were connected in shunt to the armature. Thus, at a little over 750 revolutions per minute with an exciting

1. Abstract of a paper read before the Amer. Inst. of Elec. Engrs., Niagara Falls, June 26-30, 1895.

current of four amperes, the open circuit volts were 84, rising to 104 when a load of 180 amperes was put on with an increase of the exciting current to 4.8 amperes. It was noticed that on any considerable increase of load being made, the potential rose in some cases as much as 5 or 6 volts above the point at which it would remain; or which it would reach after a short interval. Similarly it was found that the sudden taking off of load caused a temporary fall below the stable voltage under the new or diminished load conditions. This curious effect was traced to the difference of time between that needed to build up or cut down the flux in the dead poles, as compared with that required to cut down or build up the excited poles, which, being wound with wire, were naturally more sluggish under the conditions of use.

Horizontal plottings of the potentials generated in the armature coils under various no loads obtained by the two brush method of Dr. S. P. Thompson, are given, among them two for abnormal or extreme loads. The latter show how completely the wound pole is broken down by armature reaction, and how the unwound poles become the chief working field poles, or rather how the armature winding itself furnishes the field for its own cutting.

The machine described is probably chiefly interesting from a theoretical aspect. Still it shows clearly that so far as the effect of the series field on compound wound machines is concerned, the electrical engineer has other resources at his command giving similar results.

In conclusion it may be stated that tests of the machine used to generate single phase and three phase alternating currents in its armature winding were made by dispensing with the commutator and substituting rings and connections common in such cases. The results indicated a substantially similar effect of compounding, but to a less degree, owing no doubt to the fact that the phase of the electro-motive force generated by the wound pole flux would not coincide with that due to reaction on the dead poles, since the position of the poles with relation to any portion of the moving wire is different at the same instant.

SOME FEATURES OF ALTERNATING CURRENT SYSTEMS.[1]

BY CHAS. PROTEUS STEINMETZ.

The alternating current generator, single phase, or polyphase, when running at synchronism in parallel with other generators, will keep on revolving even if the driving power is removed, and will operate as a "synchronous motor" keeping absolutely in step with the generator. Such synchronous motors are quite extensively used now, especially for large units. They have, however, the disadvantage that they are not self-starting, but have to be brought up to full synchronism before operating as reversed generators. Thus, either external starting devices had to be used or the synchronous motor made what is called "self-starting;" that is, built so as to operate in starting and running below synchronism on a different principle, namely, that of the asynchronous, or induction motor, or that variety of the latter which is called the "reaction motor." Thus, the reversibility of the alternating current generator did not bring the solution of the motor problem.

The solution of the alternating current motor problem had to be expected, either by the adaptation of the continuous current motor to alternating current circuits, or by the discovery of an entirely new principle. The introduction of polyphase systems appeared to give the solution in the polyphase induction motor. This motor necessitates the use of polyphase systems, that is, systems comprising several circuits differing from each other in phase of their E. M. F.'s and currents. Such polyphase systems require the subdivision of the single phase load, as lights, into and between several circuits, and require an approximately equal division to avoid on the one hand overloading of an individual circuit of a generator, while the generator as a whole is not yet fully oaded, and on the other hand to avoid the feature of "unbalancing" noticed in such systems.

However, aside from this difficulty, the experience of the last few years seems to show that the complication of subdividing the circuits in the polyphase system is sufficient in most cases to exclude its use, and thus, comparatively little use has been made of the polyphase system for light and power distribution. It has been different with long-distance transmission of large units, and power distribution, where polyphase systems have established themselves quite extensively.

Hence, the polyphase system did not completely solve the problem of alternating current light and power distribution, and in returning to the single phase system, attempts were made to derive from the single phase system by "splitting of phase," a polyphase system for the operation of motors.

The futility of all attempts to derive a polyphase system from a single phase system, I have previously shown.[2]

It is possible in a single phase system to resolve the E. M. F.'s into components in quadrature with each other or in any other phase relation. The insertion of a reactive coil into a lamp circuit produces two E. M. F.'s approximately in quadrature with each other and differing in phase with the main E. M. F., and by their combination any other phase differences can easily be produced. A condenser in series in the circuit, or an electrolytic cell will give phase displacement of E. M. F. also. But whenever E. M. F.'s displaced in phase are produced in this way, the currents are in phase with each other or are insignificant.

Inversely, differences of phase of current can be produced in the single phase circuit. The current in an open magnetic circuit transformer at open secondary circuit and the current in a transformer under full load, are practically in quadrature. Or still more, if on the same iron core two coils are wound and connected in parallel, the two currents in these coils can by changing the relative number of turns be made to have any phase difference from zero to 180°, but the E. M. F.'s are in phase. All attempts to produce such phase differences in the single phase circuit for the operation of polyphase motors signally failed. While it is possible to operate motors in this way, and this is being done to a certain extent, the current required is far in excess of the torque produced thereby. Such circuits of displaced phase lose their phase displacement as soon as work is required from them. The cause is that phase displacement of current, and phase displacement of E. M. F. cannot be produced simultaneously in a single phase circuit. This is a consequence of the law of conservation of energy.

According to the law of conservation of energy, a change from a single phase to a polyphase circuit or inversely, is possible only by means of apparatus able to store energy, and that the total amount of energy between the mean and maximum value in the single phase circuit must be stored and returned during the time the single phase wave is below the mean. Means to store the energy are, electro-magnetism, electro-static charge, electro-chemical force and mechanical motion. Electro-magnetic and electro static storage are in most cases excluded by low energy efficiency and especially low weight efficiency and inconvenience. Electro chemical storage shows a very low efficiency, and the only efficient way of storing energy appears to be mechanical momentum. This offers a high weight efficiency also, but is for most cases excluded by the complication due to revolving machinery. Excluding storage of energy, we see that the nature of the flow of energy constitutes an essential feature of an alternating current system.

The systems are characterized correctly, not by the existence of one or several phases, but by the existence of one or several waves of energy, or cycles, and for this reason I rather prefer the denotation "polycyclic" for a system of many waves of energy, "monocyclic" for a system with one wave of energy. Hence:

The monocyclic system is an alternating current system of balance factor zero.

The balanced polycyclic system has the balance factor one.

The three phase or quarter phase system with equal load on all branches has the balance factor one.

A three phase system with two branches loaded and one unloaded has the balance factor .5.

A three phase system with one branch loaded and two unloaded has the balance factor zero.

A quarter phase system with one branch loaded and the other unloaded has the balance factor zero.

Still from another point of view, we are driven to recognize the importance of the flow of energy as characteristic in alternating current circuits.

In a continuous current circuit, the direction of transmission, or direction from the generator to the consumer circuit, is in the direction of decreasing voltage.

The direction of transmission in an alternating current circuit is not necessarily the direction of decreasing voltage or decreasing current, but it is the direction of decreasing energy flow. That is, attaching a wattmeter to two points of the line, the wattmeter nearer the generator will always give a higher reading than that farther away from the generator.

The author then discusses as an instance of a polycylic system of a balance factor less than unity, the "Inverted Three-phase System" ("polyphase monocyclic"), and concludes that:

The multiple-circuit generator regulates, or tends to regulate, near the maximum output point for constancy of the balance factor. Thus, the polycyclic machine with balanced circuit regulates for constancy of the flow of energy; the monocyclic machine regulates for a balance factor zero.

This self-regulation takes place by a change of voltage and a shifting of phase of the different generator circuits. It is therefore in general objectionable. A similiar action takes place in multiple circuit motors, induction motors as well as synchronous motors, etc.

It is thus obvious that, with a considerable number of multiple circuit motors in the polycyclic system, even a large inequality in the distribution of the single phase consumer circuits, as lights, between the generator branches, will not unbalance the system. The generator will regulate for constant flow of energy

1. Abstract of a paper read before the Amer. Inst. of Elec. Engrs., Niagara Falls, June 26-30, 1895.

2. TRANSACTIONS 1892, vol. ix, p. 91.

and tend to raise the voltage on the lesser loaded, to lower it on the more loaded branch.

The problem of the alternating current motor may be approached from still another side, from the viewpoint of adapting the continuous current motor to alternating current circuits. In similar lines to this, work has been done by Vandepoele, Eickemeyer, Stanley, myself, and others in this country, by Kennedy and others abroad.

The possibility of operating such a motor successfully is based on the feature that the armature coils when reaching the brushes are in a position where no E. M. F. is induced in them, and they can thus be short-circuited by the brushes, in their passage from the one to the other side, without sparking. Such motors, straight, alternating current series motors with laminated field, have been tried but have been a complete failure in all but the smallest sizes, as fan motors, due to their excessive and incurable sparking.

In the continuous current motor the use of brushes and thus of a commutator constitutes the only way to produce the current in the armature. In the alternating current motor the required current in the armature can be produced by induction, by acting upon the armature as secondary in the proper direction by a primary coil, which may directly surround the armature.

To get the field excitation in phase with the main current, the exciting current must be in phase with the main E. M. F. Since, however, in an alternating magnetic circuit, the magnetizing current lags approximately 90° behind the impressed E. M. F., it follows that the E. M. F. impressed upon the field circuit must be 90° ahead of the main E. M. F. Or in other words to produce in such a transformer motor a magnetic field in phase with the induced armature current, but displaced at right angles in space, a supplementary E. M. F. is required approximately 90° displaced from the main or power E. M. F. Being in quadrature with its current, this E. M. F. represents no power and thus need not be supplied by the generator, but may originate from a motor or other multiple circuit apparatus.

We see thus that the alternating current motor requires a supplementary circuit for its operation, the so-called "teaser circuit" of the monocyclic system. One difficulty, however, is met here. Since the movable armature acts as secondary to the stationary primary main circuit, the armature must contain a number of circuits closed upon themselves, but displaced in position from each other so as to form in any position a secondary circuit to the primary.

We have now arrived at the modification assumed by the continuous current motor in its adaptation to alternating current circuits: 1st.—The armature current is induced by a primary energy circuit, instead of being led in by brushes. 2nd.—To keep the field excitation in phase with the armature current, it is derived from an auxiliary circuit of displaced E. M. F. 3rd.—To avoid energy transfer between field exciting circuit and armature, the E. M. F. at the terminals of the field exciting coil is kept approximately equal to the E. M. F. induced in the armature, by the internal reactions of the system. This is the monocyclic motor.

The calculation of such a motor is now simple, and done after the manner of the previous explanation of its action. The torque, and thus the output of the motor are determined by the field magnetization, the armature current, and the angular space displacement between them. The field magnetization is determined by the impressed E. M. F. of the exciting circuit, and the armature current is determined by the equations of the alternating current transformer, as secondary currents induced by the primary energy current. Since no energy transfer should take place between the exciting circuit and the armature, it follows that the counter E. M. F. at the exciting circuit is equal to the E. M. F. induced in the armature, and thus the magnetic flux can be calculated from the latter.

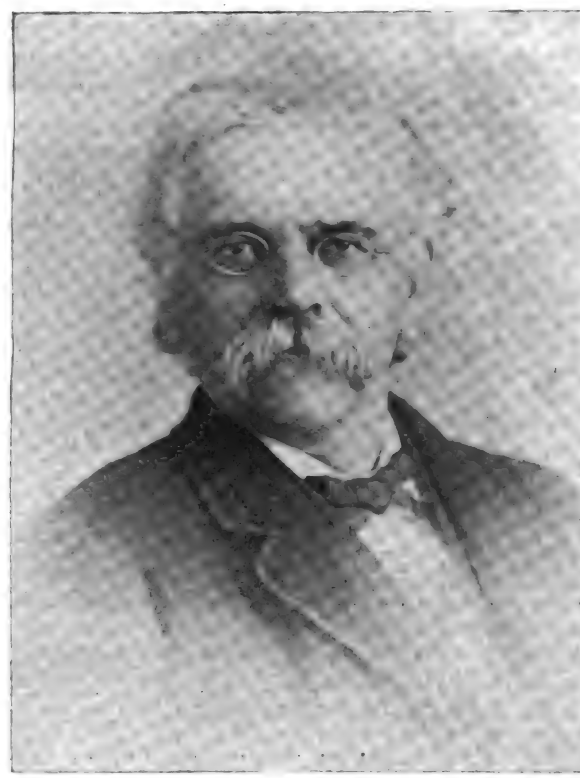
"THE ELECTRICAL ENGINEER" ON ELECTRICITY IN CALIFORNIA AND MEXICO.

During the past six months THE ELECTRICAL ENGINEER has been publishing a series of articles by Mr. George H. Guy, its special correspondent, on the leading electrical features of Mexico, California and the Southwest. These have been read with great pleasure and highly commended, many letters of thanks and praise reaching us with regard to them. One of the most recent of these comments is from Mr. T. T. Crittenden, Consul General of the United States, City of Mexico, who under date of June 24, writes with regard to Mr. Guy's article on the Government Telegraphs of Mexico: "I don't know when I have enjoyed an article more. While I have often used the service and with satisfaction, I freely admit that I knew nothing of its organization under Senor Islas, until I read this singularly interesting article. It is as often true that we have to go away from home to get facts, as to get the ordinary news of society. Mr. Guy has an excellent conception of Mexico. It is a coming country." Mr. Crittend en is a man of much influence and high standing in Mexico, and his commendation carries weight.

OBITUARY.

JOSEPH BARKER STEARNS.

We regret to note the death of Joseph Barker Stearns, inventor of the duplex system of telegraphy, who passed away at Camden, Me., on July 4, at the age of 65. He was born at Weld, Me., on February 28, 1831, learned telegraphy at Newburyport, Mass., and became superintendent of fire alarm telegraphs in Boston in 1855, holding the position until 1869. He afterwards became president of the Franklin Telegraph Company, remaining so until 1871. He had already patented the method of using reversed currents in connection with fire alarm signals; and he now won fame by introducing the first practical system of duplex telegraphy, which was put into use on the Franklin lines between Boston and New York. His duplex was next applied successfully to the Atlantic cables, and his patents were sold to the Western Union Company, and the various cable companies, the sale being the means of bringing him considerable wealth. Mr. Stearns supervised the laying of the cables of the Central and South American Telegraph Co., and during 1882 and 1883 he was vice president of the Mexican and South American Cable Co. Of late years he has spent a well earned leisure at his beautiful home at Camden, Me., on which he lavished time and money. Our portrait is reproduced from Mr. J. B. Taltavall's admirable book: "Telegraphers of To-Day."



JOSEPH BARKER STEARNS.

OPPOSING A "POWER BRIDGE" AT BUFFALO.

United States Engineer Major Ruffner has put his veto on the plans of ambitious Niagara River harnessers, who propose to develop power at Buffalo, by the construction of bridges and piers. Some time ago Major Ruffner wrote to Gov. Morton, advising him to disapprove the Mather bill, because the proposed bridge would, in his opinion, be an obstruction to navigation, hinting that, even if the Governor should approve the bill, the Federal Government would never permit the bridge to be built. Last week Major Ruffner gave expression to his views in a very emphatic manner to one of the inventors. He said that, while the plans were good ones for developing power, he would be compelled to report against allowing such obstructions in the river. Major Ruffner said further: "The present international bridge would never have been built had not the right been obtained just after the war, when things were so unsettled. Another franchise could not be bought for $20,000. What is more, the City of Buffalo could not, under any circumstances, get permission to build another inlet pier.

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CONTENTS.

ELECTRIC RAILWAY WORK.

It is natural that the recent successful equipment of the Nantasket Beach road with electrical apparatus by a large steam railroad company, and the successful application of electricity to the hauling of heavy trains through the Baltimore tunnel should attract widespread attention. Indeed, the interest in these two subjects is universal, and there appears to be on the part of the public an expectancy that *now* steam is to give way and the time-honored locomotive be at once relegated to obscurity and oblivion.

We are free to admit our own belief that two such events are very important in marking the arrival at a stage when electricity has so far demonstrated its value that it must enter into the survey and calculations of all steam railroad managers in the future when the question arises of equipping new branch roads or of meeting the competition of the trolley parallel. In this respect, the work at Nantasket Beach has an instructiveness that cannot be surpassed. The change there has been made by a company which, perhaps, more than any other has suffered from the diversion of its local passenger traffic by the trolley, all along its system; and the apparatus is in many respects novel, indicating an attempt to reconcile and combine the best features of the old with the best qualities of the new. How far the blending will answer the purpose elsewhere remains to be seen. The success of the trolley lies largely in its flexibility, in its ease of penetration into remote localities, and we do not think that the old steam roads can be adapted to do this; although it will probably turn out that there is economy over the old steam methods in the adoption of electricity even for the existing tracks.

The work at Baltimore is remarkably interesting, and the huge electric locomotives are confessedly marvels of skill and ingenuity. That they should meet the task put upon them does not surprise us, and that they must be so powerful is a necessity of the case; but as a matter of fact, it seems to us that the real lessons of electric traction lie rather in another direction. There will be a few cases in which such heavy machines and such tractive ability are required; but the field of their use is surely very limited. If steam railroad capitalists and managers welcome electricity, it is not because it adds to the burdens put upon the track, the bridges and the structure of the line generally, but because it offers surcease from the tendencies that of late have asserted themselves in an intolerable manner. What all the roads really need is lighter engines, lighter trains, lighter tracks, lighter investment in line and in rolling stock; and if electricity is simply going to add to the ponderosity of everything, steam railroad men will want none of it.

Of the two sharply contrasted types of electric locomotion thus brought forward within a fortnight, at Nantasket Beach and Baltimore, it does seem, therefore, that the former marks the proper line of development rather than the latter. New conditions of electric current generation and supply may come in, but it will still remain open to question whether it is not better to cultivate the unit system up to the fullest extent rather than strain after the massing system of enormously heavy trains. For the present, at least, the whole success of electricity lies in a study and cultivation of the unit methods, and the dis-

patch of cars at frequent intervals rather than in the running of big locomotives and weighty trains at intervals widely apart.

REVENUE FROM ELECTRIC HEATING.

The Ottawa, Can., Electric Co. has proved itself one of the most progressive lighting companies on this continent. The fact that in a city with a population of but 40,000, it runs 50,000 lights, speaks volumes, and we question whether any other city in the world can approach such figures. But even more interesting is an item in president Ahearn's last report, just presented, showing an income of $421 from heaters. We have not struck this item in any similar balance sheet before, and make its acquaintance with a great deal of pleasure. The expenses, per contra, charged against heaters, are only $12, from which we infer that the service must be quite profitable. It is true that $421 is not a large proportion of the $147,000 received for all services, including incandescents, arcs and motors, but it is a decided beginning and is much larger than the motor account once was with some incandescent companies or the incandescent account with many large arc companies. The Ottawa example of more than 1 lamp per head of population, and of $421 revenue from heaters at an incidental outlay of only $12, is a mighty good one to copy.

THE DEADLY FENDER.

After having clamored with might and main for fenders on the street cars, some of the newspapers in such cities as Brooklyn and Philadelphia are now beginning to kick and complain because the fenders adopted don't work wonders and perform miracles. Just what our friends of the daily press expected, it is rather difficult to ascertain; but judging from their own reports the fender is far more deadly than the trolley. When not deadly, the fenders display remarkable powers of mutilation, and some of the reporters who have been writing articles on: "A Fence with a Fender"; "Braving the Juggernaut"; "An Experience as a Human Pancake"; "Thrilling Bouts with the Trolley Calfcatcher," are now nursing alike their bruises and their wrath. The idea seems to have been that a fender would naturally serve as a gentle hammock, but because it hits hard and is no respecter of persons, it is being unanimously voted a dismal failure by the secular press. Moreover, a great dispute is arising as to what constitutes a fender, and various civic authorities are endeavoring to define what it is and what it is not.

Of course the street railway companies that are expending hard dollars by the thousand to equip their cars look on wellnigh hopelessly, and are still casting around for something that will serve the purpose and satisfy the public. Mr. Rossiter, the new president of the Brooklyn Heights road, finds it his first duty, for example, to fit 2,000 cars with fenders, and he admits that the officers have not yet found exactly what they want. We opine that it will be some time before he succeeds in pleasing the press, let his search be as earnest as it will.

As we have said before and now repeat, good brakes are more necessary to the cars than poor fenders; and we hope ere long to see public opinion intelligently directed to that part of the subject. But with the best of brakes, suicide will remain possible to those who seek to kill themselves on the trolley lines. As one of the Philadelphia papers says, the city itself owes some duties to the citizens other than putting petticoats around the cars, and the necessity of rapid transit must not be subordinated to the unchecked carelessness of stupid foot-passengers. In other words, it approves the Berlin rule that arrests the man who is run over. Speaking of the children, it says, very sensibly:—"There is but one power that can keep children from the streets, and that is the power of the police. There is not a day that scores of children cannot be seen playing on the streets occupied by trolley lines in every part of the city, and until they are forbidden by the police, and arrested when they disobey the order of the city authorities, there will be no safety for children, fenders or no fenders. Children must be protected by a stronger power than themselves, and the only power that can protect them in a great city is the power of the municipality."

The above quotation is a cheering sign that the discussion of trolley car accidents is at the stage when the truth is about to prevail.

JUDGE COXE'S TROLLEY SWITCH DECISION.

So many patents of a fundamental character and far-reaching importance in the electric arts have been declared void by the courts that confidence has been much shaken in the adequacy or value of patent protection. Indeed, one world-renowned inventor has been heard to condemn our whole patent system as a legal method of extorting money from the poor inventor. Nevertheless some recent decisions may serve to give inventors renewed faith in the wisdom and equity of the patent laws; and it is to be noted that the patents covering extensively applied, though secondary, details have been sustained in large part, if not fully, in several instances of late. The most recent case, and one of considerable importance in railway work, is the patent of Van Depoele, No. 424,695 issued April 1, 1890, for "Improvements in Suspended Switches and Traveling Contacts for Electric Railways," which has just been sustained as to its principal points by Judge Coxe, in the suit brought by the Thomson-Houston Electric Co. *vs.* Elmira and Horseheads Railway Co. In his opinion the learned judge pays a glowing tribute to the ability and prescience of Van Depoele as an inventor, and thus brushes aside the arguments of the defense that the arrangement of track-switch, conductor switch, vehicle and contact device by means of which the former switch will act in advance of the latter and the vehicle impart a lateral tendency to the trailing contact by the time it engages with the conductor switch,—involved no invention. On the contrary Judge Coxe, holds that the record shows that Van Depoele's contributions to the art rapidly supplanted the crude and tentative prior structures and have continued in use up to the present time. Of the thirty-five claims embodied in the patent quite a number are so nearly identical in character and scope that the court could find no legal distinction between them but the claims most relied on by the complainants and which are fully sustained are as follows.

2. The combination, with an overhead conductor arranged to receive a traveling underneath contact, of a switching device secured to and depending from the conductor.

4. The combination of a track having switches, an overhead conductor above the track and having switches, and a car on the track provided with a contact carrying arm to engage the conductor at a point in rear of the front wheels of the car.

9. In an electric railway, a switching device for suspended conductors, comprising two or more branching compartments or ways corresponding to the direction of the track, and of the main and branch conductors, and secured to the said suspended conductors, substantially as described.

20. In an electric railway, the combination, with an overhead switch-plate having depending ribs, but open at its extremities, of main and branch conductors extending from its two extremities, respectively, a vehicle, an upwardly-pressed contact-arm attached to the vehicle and tending to move laterally therewith, and a track-switch for the vehicle located so as to operate in advance of the conductor-switch.

It will be noted that some of these claims are very broad and the decision appears to be of far reaching importance in electric railway work.

ELECTRIC TRANSPORTATION DEPARTMENT.

Power House, B. & O. Tunnel Electric Railway, Baltimore.

THE ELECTRIC LOCOMOTIVES AND POWER PLANT OF THE BALTIMORE & OHIO RAILROAD AT BALTIMORE.

I.

The new Belt Line tunnel in Baltimore, on the main line of the Baltimore & Ohio Railroad through the City of Baltimore was undertaken to give this railroad a clear route through to the North. Previous to its completion all trains on the Baltimore & Ohio Railroad running between Baltimore and the North were compelled to take a devious course, and were transferred to a ferry running between Locust Point and Canton. The delay which this water transfer entailed acted for many years to the great disadvantage of the company, as other lines had a clear all rail route through the city. To do away with this delay, the Baltimore & Ohio Railroad secured legislative permission to construct a tunnel under the city, and in September, 1890, work was begun upon the tunnel and line which now runs from Camden Station, in the heart of the city, north, and then east to Bay View Junction, a distance of 7.2 miles.

To construct this road the Belt Line Company was formed, and the actual construction of the tunnel and line was carried out by the Maryland Construction Company, a company formed for that purpose. The tunnel is one of the longest soft earth tunnels ever driven, and runs through the centre of the city, immediately under Howard street, one of Baltimore's principal thoroughfares. The length of the tunnel is 7,389 feet, and the maximum dimensions, after lining, are twenty-seven feet wide by twenty-two feet high. Its cost, ready for the track, is set down at $225 a lineal foot.

II.

With the project for the construction of the tunnel the question of its ventilation became urgent. The disadvantages of its operation by steam locomotives were patent, and it became necessary to find a means of doing away with the smoke and gases either by a scheme of ventilation or the abandonment of steam locomotion in the tunnel. Cable traction was suggested, and other schemes, but all in turn were rejected as inadequate or unsatisfactory. The General Electric Company then offered to undertake the construction of electric locomotives of capacity sufficient to haul the heaviest trains, effect the entire equipment of the system, both for lighting and power, and thus to solve the ventilation problem.

Briefly, the electrical equipment and the work as first outlined was as follows: The locomotives were to operate from Henrietta Street about 1,800 ft. in the open to the portal of the tunnel at Camden Street, and thence to the further end at Mt. Royal Avenue, and for 4,600 ft. further on in the open, or a total distance of about 14,500 ft. The locomotives were to join the rear end of passenger trains going north, at Henrietta Street, and push both cars and locomotives through to the second station, from which point the steam locomotive was to do all the hauling. Freight trains were to be pushed the entire distance. The calculations were to be based on a maximum weight of 500 tons for each passenger train, including the steam locomotives, with a speed of thirty-five miles an hour, and on a maximum weight of freight trains of 1,200 tons at a speed of about fifteen miles an hour, on a grade of 0.8 per cent. The number of trains each way was to be about 100 a day. An electric lighting plant with large incandescent lamps for the tunnel, and arc lights for the stations, was also contemplated.

III.

The power house stands upon the west side of Howard street, east of the tracks leading to the southern portal, and between Henrietta and Montgomery Streets, two blocks south of the Camden station of the Baltimore & Ohio Railway. It is a one story building rising thirty feet from floor to eaves, with walls of brick one foot five inches thick. The roof of slate is supported on iron trusses, and the building is practically fireproof. It is divided into two parts, the engine room occupying the north portion, being separated from the boiler room by a brick wall. The entire length of the building is 322 ft. 1 in. long; the dimensions of the engine room are 223 ft. 10 ins. in length by 67 ft. 9 ins. wide, and of the boiler house 98 ft. 3 in. by 69 ft. wide.

The boiler house is a spacious and lofty room, having twelve boilers (250 H. P.) arranged in six batteries, three of which are placed on each side of the center passage. It is lighted from the roof. The boilers are of the Root water tube type, made by the Abendroth & Root Manufacturing Company. Each boiler is twelve tubes wide and eleven tubes high with six 14½ inch drums

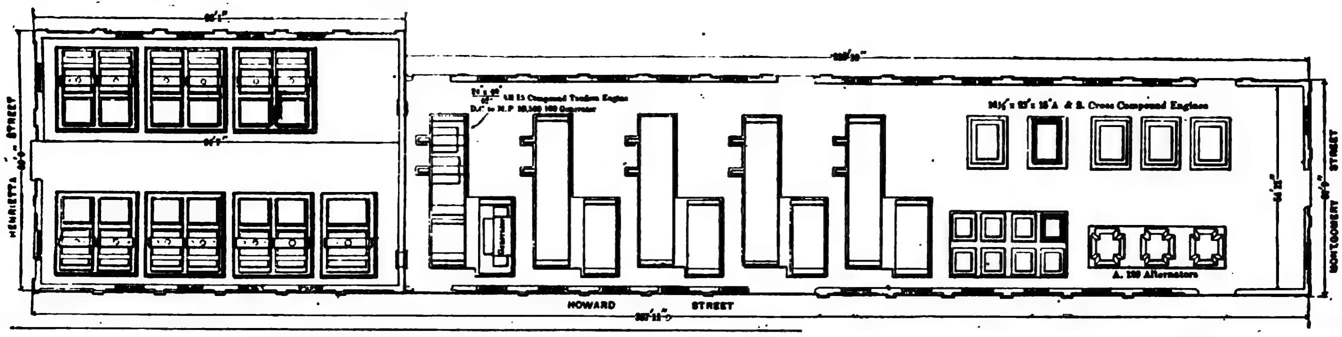
ABENDROTH & ROOT BOILER PLANT, BALTIMORE TUNNEL.

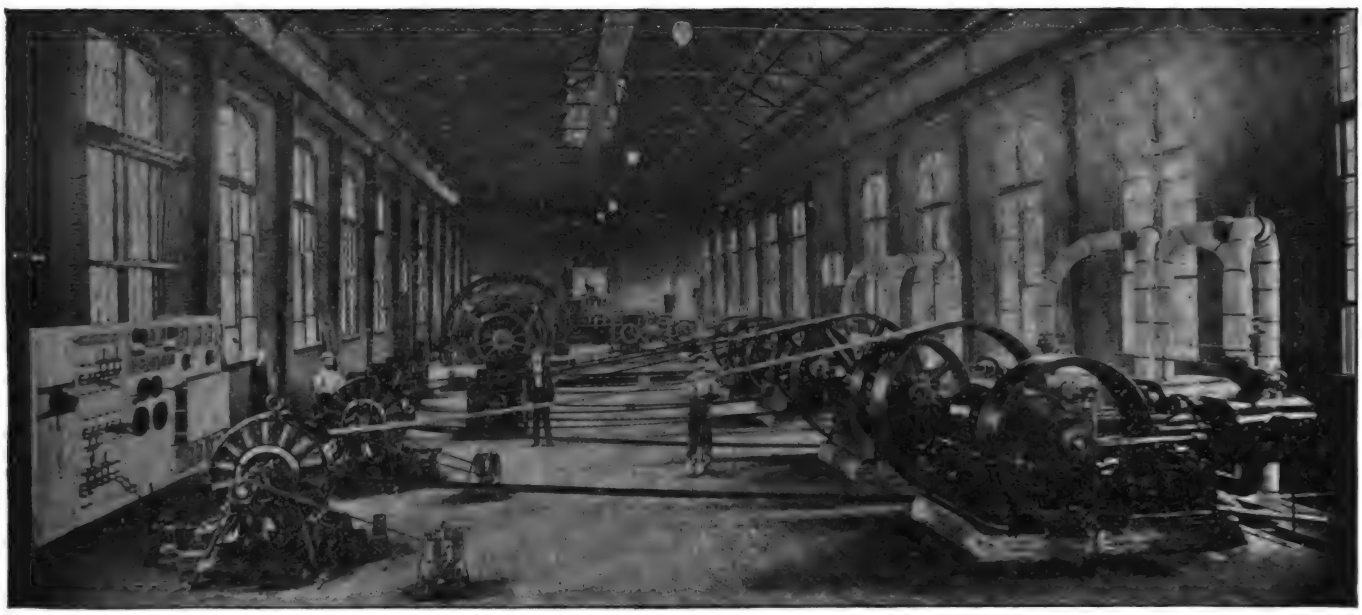
and a thirty inch steam drum. Space is left for an additional boiler on the west side of the room.

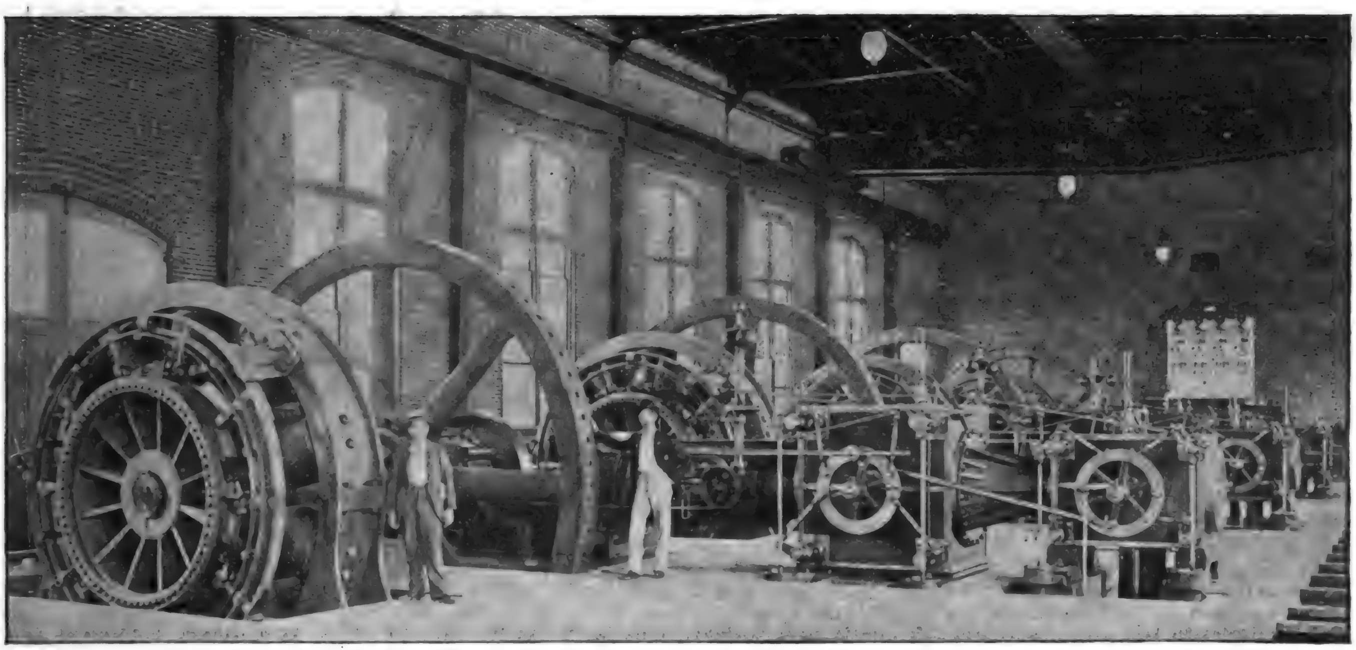
A system of mechanical draft is employed with two fans of the Sturtevant pressure pattern. Each fan is belt driven by a ten horse power vertical engine, set up on the floor of the boiler room, and one is of sufficient capacity to secure the necessary draft.

The boiler room is further equipped with a C. W. Hunt coal crusher and conveyor, which brings the coal to the boiler and carries away the ashes from the ash pits; with Dean duplex feed water pumps, and a 3,000 H. P. Webster feed water heater.

The steam system is duplicate throughout, and was laid out in the Engineering Department of the General Electric Company. Sudden demands for steam likely to be made at times, necessi-







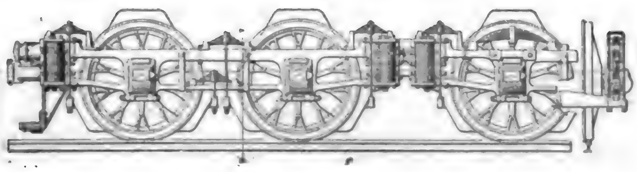
Plan of Steam and Electric Plant and Interior of Engine and Generator Room.

prevents its passage into the engine room system. Each main is provided with a forty-eight inch separator. A novel addition to each boiler is the angle check and stop valve which shuts off automatically from the system any boiler in which a tube has given way, or any part of which has met with an accident.
tated special provision to take care of any water that might be siphoned over from the boilers into the system. The mains from the boilers are, therefore, placed high enough to allow the water to drop into the separators, whence a "Lux" drip system returns all water from this point back into the boilers by gravity, and

A twenty-four inch separator is furnished to each power engine, and one of similar size for each pair of lighting engines. The Holly drip system, described and illustrated in the Engineer of April 24, is used in the engine room, and is connected with the separators at the engines, the valves and expansion joints, wherever there is the slightest pocket in which water could lodge, returning it to the boilers, with only a slight drop in the temperature. The steam piping is protected by Keasbey & Mattison magnesia covering.

The engine room is divided into two sections, one devoted to

the power plant, the other occupied by the lighting generators. In the power section space has been provided for five direct connected engines and generators, and four are now in place. The engines are horizontal, tandem compound Reynolds-Corliss machines, from the shops of E. P. Allis & Company, and have 24 and 40 × 42 in. cylinders. Directly coupled to them are 500 K. W. General Electric multipolar generators, adapted to run with the engine at 110 revolutions per minute. The armatures of these generators are "overhung" on the outer end of the shaft, differing in this respect from the regular practice of railway generators. The armatures are wound for 700 volts potential and are of the iron clad type. i. e., the windings are embedded in slots



TRUCKS, SHOWING METHOD OF COUPLING.

cut into the outer periphery of the laminated armature body. The armatures are of the latest barrel wound type and the machine compounds from 600 volts no load to 700 volts full load.

IV.

From the railway generators the current is brought over cables of 1,000,000 C. M. cross section, to a switchboard of white marble, erected on a platform raised at the south end of the engine room. This switchboard consists of four standard "K" generator panels, each equipped with all the necessary instruments for controlling and measuring the current from one generator. The machines are protected from accident arising from short circuit by automatic circuit breakers, one of which is fixed to the upper part of each panel.

The northern section of the engine room contains the lighting plant, consisting of eight fifty-light Thomson-Houston arc generators, and two alternators for the incandescent lamp service in the tunnel. The arc light machines are belted to two cross compound Armington & Sims 250 H. P. engines, $16\frac{1}{2} \times 28 \times 19$ ins. Two other engines, of similar make and capacity, drive the two alternators, and space has been left for an additional engine and alternator. Each alternating generator has a capacity of 2,000 sixteen candle power lamps, and as the tunnel is lighted by 1,000 thirty-two candle power lamps, one alternator will suffice for the present illumination of the tunnel. Facing the lighting plant, on the east side of the room, is the lighting switchboard, also of polished white marble. It consists of one standard, twenty circuit, arc lamp plug board to which only sixteen circuits are at present connected; three alternating generator panels, one of which is left blank, and one feeder panel. The arc lamps used in the illumination of the power house are of the Thomson 1893 type. In addition, it is lighted by clusters of three incandescent lamps each, fixed to the walls. The approaches and stations are lighted by Thomson-Houston standard arc lamps.

From the positive bus on the railway switchboard, eight cables of stranded copper, each of 500,000 C. M. cross section, or a total cross section of 4,000,000 C. M., pass to the overhead structure immediately outside the power house, where connection is made to three feeder cables, of 1,000,000 C. M. cross section each, and to the overhead conductor itself, which has an equivalent of 1,000,000 C. M. cross section. The negative bus is similarly connected to the rails, which are double bonded with No. 0000 wire, and also to the return cables laid in a wooden box between the tracks. Perfect contact between bonds and web is obtained by using a hollow rivet on each end of each bond and expanding it, when inserted in the rail by means of a conical steel pin.

V.

The distance over which the electrical locomotives will operate is about 15,000 ft., passing through two tunnels, 7,339 ft. and 265 ft. long, respectively, and over 7,396 ft. of track in the open from Hamburg Street to Huntington Avenue. Three tracks are laid into the southern portal, two tracks passing through the tunnel, four tracks from the northern portal, through the Mt. Royal Avenue arch, and two tracks as far as Huntington Avenue, where a siding is provided for the electrical locomotives. There is a steady grade of .8 per cent. from the southern through to the northern portal, and the lines in the open have two equated curves of 10 degs., with a steady gradient of $1\frac{1}{2}$ per cent. At the power house end of the line the locomotives run on a siding at the beginning of the long open cut running down to the southern portal.

The operation of the freight trains will begin at the main tracks south of the Camden station, where they will be switched into the cut. The electric locomotive will then couple on behind, without stopping the train, and push it through as far as the Mt. Royal Avenue portal, a distance of 8,146 ft., the steam locomotive doing no work. After passing out of the tunnel, both steam and electric locomotives pull and push together up the heavier grade as far as Huntington Avenue, the average speed over the entire distance being about fifteen miles an hour. At Huntington Avenue the electric locomotive will uncouple and run into its siding.

The plan of pushing the passenger trains through the tunnels has been abandoned, in view of the possible results if one of the cars or the steam locomotive should leave the track, in front of the heavy electric locomotive traveling at thirty miles an hour. The passenger trains will, therefore, be pulled through from the Lombard Street station near the south end of the tunnel to the Bolton Street station at the north end.

VI.

The 96-ton locomotive, built by the General Electric Co., has the following dimensions and capacity :

Number of trucks	2
Number of motors	4—2 to each truck.
Weight on driving wheels	192,000 lbs. (96 tons).
Number of driving wheels	8
Drawbar pull	42 000 lbs.
Starting drawbar pull	60,000 lbs.
Gauge	4 ft. 8½ ins.
Diameter of drivers	62 ins. outside of tires.
Length over all	35 ft.
Height to top of cab	14 ft. 3 ins.
Wheel base of each truck	6 ft. 10 ins.
Extreme width	9 ft. 6½ ins.
Diameter of sleeve bearings	13 ins.

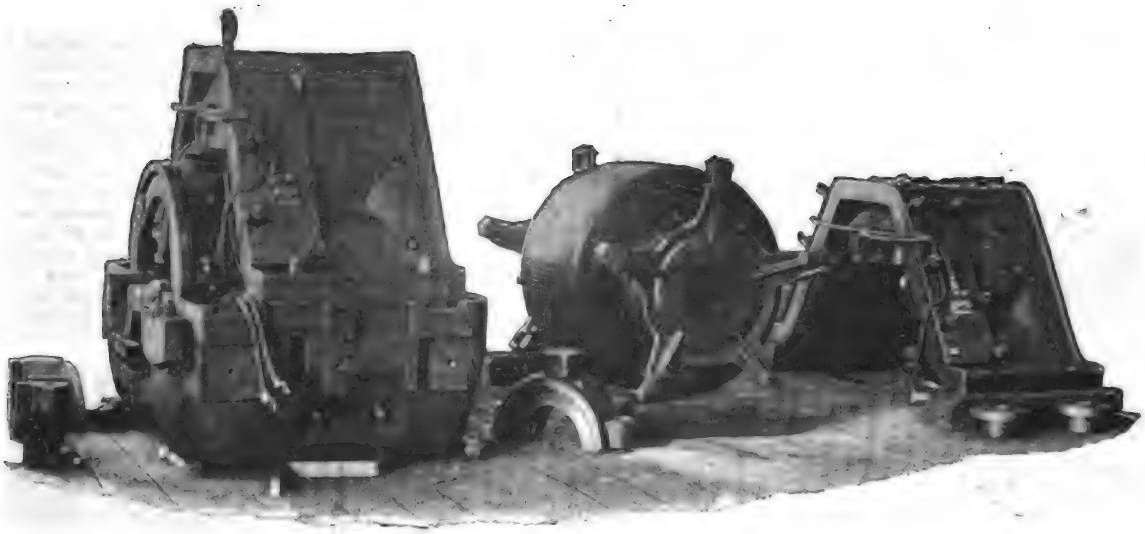
The driving gear consists of a cast steel spider shrunk on and keyed to a cast steel driving sleeve, having a tensile strength of

END VIEW OF ELECTRIC LOCOMOTIVE.

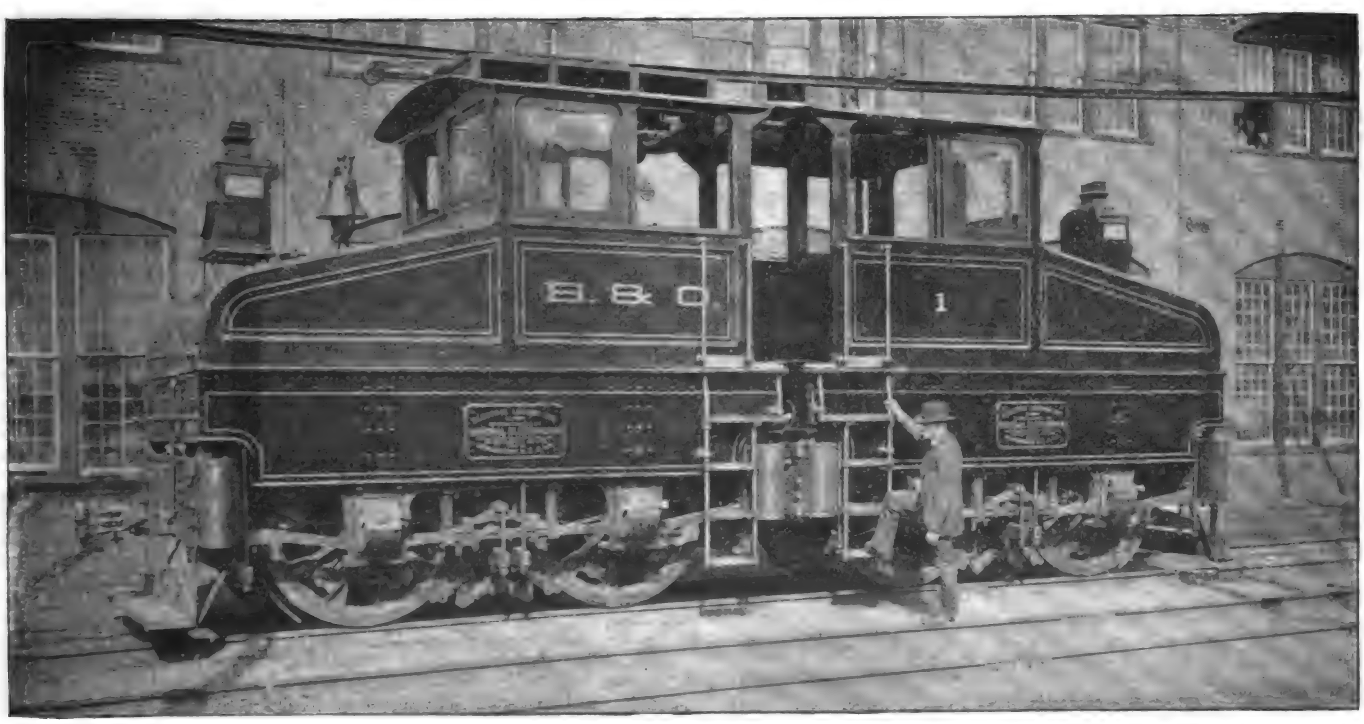
not less than 80,000 lbs. Each arm of the spider is provided with a double rubber cushion, with a chilled cast iron wearing cap, the cushion being forced into the arms of the spider and the cap. The eight driving wheels are of cast steel pressed and keyed to the axles, and have tires, three inches thick at centers of tread shrunk onto the wheel centers. The driving axles are of special open hearth steel. The journal bearings are outside the driving wheels and allow of easy access to all parts of the truck frame and driving box. In the design of this are embodied the good features of the steam locomotive driving box and passenger car box.

The two opposite side frames of each truck rest upon four wheels, each consisting of one piece of hammered wrought iron, $3\frac{1}{2}$ ins. thick, to which the frame jaws are welded, and protected from wear by cast iron shoes, and are connected together at the ends by heavy forged iron plates, with oak bumper beams between them.

The drawheads are of the Janney type, similar to those used on the Baltimore & Ohio passenger locomotive tenders, and are made of cast steel with wrought iron knuckles. In coupling with freight trains the ordinary link and pin will suffice; but for passenger service the Janney couplers, with which each locomotive is provided, are used. The front and back of the locomotive is provided with safety chains, and in addition to the regular couplings, between the trucks, safety links are used. The buffers between the motors act as spacers for, and fit between plane surfaces in, the field magnets. These spacers have a complete freedom of movement which allows the field magnets to rotate when the motor is in action. These buffers and spacers are so placed as to permit the interchange and reversal of the positions of the field magnet without requiring change in the position of the spacers. The motors are supported on carriers bolted to the field magnets, and rest in adjustable hangers carried on half elliptical springs placed on top of the frame and bumpers. The frames thus carry the motors by carriers and springs, and this load is carried in turn by rubber blocks in a cast iron casing.



The Motor Unassembled.



Side View of Electric Locomotive.

The cab is of sheet steel and the arrangement is such that all the commutators are visible to the motormen.

The locomotive is fitted with sand boxes, and Westinghouse automatic driver and train brakes are provided for all wheels, bearing upon the flanges and outside tread only. A brass signal gong 8 inches in diameter is placed in the cab to be rung from either end of the locomotive. The headlights, of which there are two, are placed on the top of the shields at each end, and are twenty-three inch lights of Baltimore & Ohio standard pattern. One shield also carries a Baltimore & Ohio standard whistle, blown by compressed air. The other shield carries a standard bell, operated by an automatic air pressure bell ringer. The locomotive is painted with the standard color and design of the Baltimore & Ohio Company.

VII.

The gearless motors are four in number, two to each truck, flexibly supported and transmitting their power to the wheels through the flexible connections described above. They are of pyramidal shape, are the largest railway motors in the world and, while ponderous in appearance, are by no means so bulky as might be expected from the heavy work they have to perform. Each has six poles and six sets of carbon brushes, the brushes being connected to a yoke revolving through 360 degrees to facilitate accessibility to them. It is possible to remove four

brushes without disabling the motor. The field spools are encased in sheet iron cases and fitted over the pole pieces bolted to the field frame. The armatures are built of sheet iron laminations, and are series drum wound iron clad. The armature, with the commutator, is mounted upon and keyed to the hollow sleeve which is carried on the journals on the truck frame. The inside diameter of the sleeve is about two and a half inches larger than the axle. The entire motor is practically fireproof. Each motor is rated at 360 H. P. and takes a normal current of 900 amperes.

When normally placed, the motor rests in a position concen-

OVERHEAD WORK IN CUT.

tric to the axle, the clearance between the axle and the sleeve allowing of a flexible support. The interposition of the rubber cushions, through which the torque of the armature is transmitted to the driving wheels allows the armature to run eccentric to the axle when the motor departs from its normal position on account of any unevenness in the track. The motor is designed to allow of ready removal of the field frame for inspection or repair.

A test of the first completed truck, representing one-half of the locomotive, was made upon the tracks at the Schenectady shops of the General Electric Company. In order to obtain the necessary load, a heavy six-wheel engine was made use of and the electric locomotive truck coupled to it. The machines were then sent in opposite directions and tugged at the connecting coupling as in a tug-of-war. The electric locomotive had a slight advantage over the steam engine in weight on the driving wheels, and pulled it up and down the track with apparent ease. For the same weight upon the drivers it was shown that the electric locomotive starts a greater load than the steam locomotive. The pull being constant throughout the entire revolution of the wheel, the difficulty of variation of pull with the crank angle, as in the steam

INTERIOR OF TUNNEL.

locomotive, is eliminated. The test also proved the driving mechanism and armature couplings amply strong to transmit the torque of the armature to the axle. The controlling devices, etc., occupy the interior of the cab. The controller is erected in one half of the cab, and is of the series parallel type. The reversing lever projects through the upper plate of the controller cover. The resistances are placed around the frame beneath the floor of the cab. The locomotive is equipped with a 1,200 to 3,500 automatic circuit breaker and one 2,000 ampere magnetic cut-out, a 5,000 ampere illuminated dial Weston ammeter and one illuminated dial Weston voltmeter. The compressed air for the whistle and brakes is supplied by an oscillating cylinder electric air pump, the air tanks being placed at each end of the complete locomotive. In the cab are incandescent lights.

VIII.

Contact with the overhead conductor is effected by means of a sliding shuttle-like shoe of brass, which is fixed to a flexible support fastened to the top of the cab. This "trolley" support is diamond shaped and compressible, contracting and expanding as the height demands, and is arranged to lean on one side or the other as the locomotive runs on one side or the other of the overhead conductor. It is, however, rigid in so far as movement forward or backward over the locomotive is concerned. The current is brought to the locomotive by means of cables connected to the shoe and fastened to the "trolley" support.

The conductor is simply a reversed iron conduit or trough erected overhead on trusses in the open, and in the tunnel attached to the crown of the arch. In the open the conductor is directly over the centre of the track; in the tunnel over the cen-

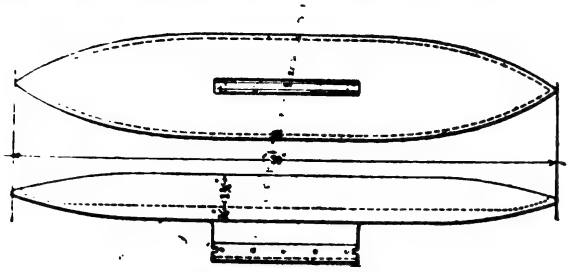
THE ENTRANCE TO THE TUNNEL.

tre line of the space between the tracks It extends from Henrietta Street on the south to Huntington Avenue on the north, a distance of 15,000 ft. The conductor consists of two 8 in. iron Z bars 3/8 in. thick, riveted to a cover plate 1/4 in. thick and 11 3/8 ins. wide, and is constructed in sections 30 ft. long. It weighs about 80 lbs. per foot. At intervals of 15 ft. inside the tunnel there are suspended from the arch, transverse frames, consisting of two 8 in. channels, held together by plates 4 ins. wide, and holding four castings into which are fitted conical porcelain insulators. In the masonry of the tunnel are fitted the bolts necessary to support these frames. They are 2 ft. 6 ins. long, have split ends, and extend 12 ins. into the masonry. The bolts pass downward through the outside pair of insulators. The bolts attaching the conductors to the channel frames pass through the inside pair of insulators and support an iron stirrup in which the conductor hangs; this method affords a double insulation. The height of the conductors above the level of the top of the rails is 17 ft. 6 ins. in the tunnel, and they are fixed a little on each side of the centre line. This plan was adopted to avoid the risk of the conductors striking brakemen who might be standing on the top of passing freight cars. An additional precaution is provided in the shape of continuous wooden shields fastened to the iron stirrup which supports the conductors.

IX.

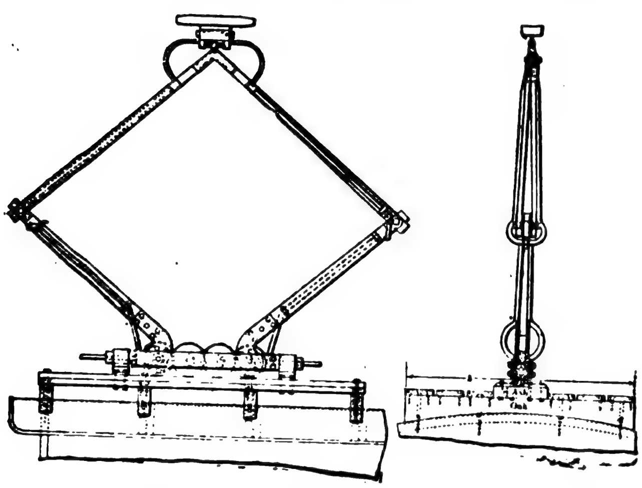
Outside the tunnel the height of the conductors above the rails is increased to twenty-two feet. The supporting structure in the

open consists of longitudinal catenaries of two chains of iron rods, having a span of 150 ft. suspended from transverse trusses, supported by columns of latticed steel channels erected on either side of the double track. The catenaries pass over the top chord of the



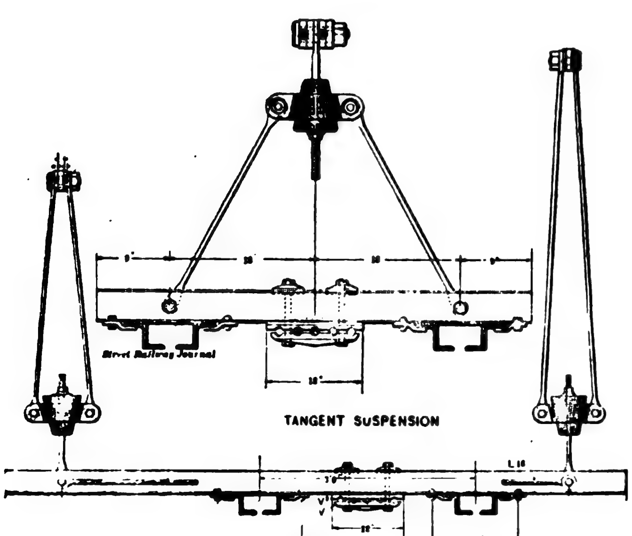
SHOE FOR TROLLEY.

transverse trusses and are fastened to a yellow pine timber post, acting as an insulation set therein. From the joints in the catenaries vertical rods are dropped at intervals of fifteen feet to support the electrical conductors. The vertical rods are attached to



SIDE AND END VIEWS OF TROLLEY.

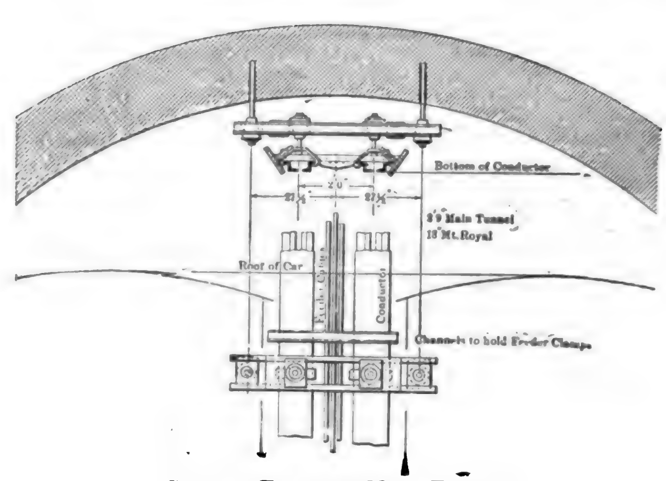
a casting holding a porcelain insulator, and through this a short bolt passes up to the joint in the catenary. The double insulation is secured by this vitrified porcelain insulator and the timber post, passing vertically through the transverse girder. A hood of galvanized iron is fixed to the top of the timber post. At the ends of the line an anchor pier receives the ends of the conductors. The trusses vary in length from 30 ft. to 62 ft., the latter being required to span five tracks. All the iron work was made by the Maryland Steel Company.



SECTION OF CURVE SUSPENSION.

Upon the straight track the conductors are suspended from single catenaries, while upon the curves a double catenary is employed, and the conical insulator is inverted and supported in a casting bolted to the two vertical rods which drop from the catenaries. The vertical rods support a channel frame to which are bolted the conductors and the feeder cleats or clamps. Each joint of the conductor is bonded with a Chicago bond of two No. 0000 wires. The feeder cables are of bare stranded copper of sixty-one strands each of 1,000,000 C. M. cross section. These are supported in iron cleats fastened to channel frames riveted to the overhead conductors at points near to the heavier channels to which the conductors are suspended.

The lead covered primaries for the tunnel lighting plant are



SECTION THROUGH MAIN TUNNEL.

carried on posts set on the side of the cut, to the southern portal, where they drop to the tunnel and are carried upon porcelain knobs fastened to wooden blocks bolted to the masonry. At the points of support the cables are armored with wire to prevent abrasion. The secondaries are carried in cleats, also fastened to wooden blocks, similarly attached, and placed on either side of the tunnel about eight feet from the ground and fifteen feet apart. They are, however, staggered, and thus occur alternately at every seven and a-half feet throughout the tunnel. Each block carries a lamp at its lower end, and is there cut out so that the lamp socket may be protected from moisture and dripping water from the tunnel walls. The lamps used are thirty-two candle power, fifty-two volt Edison standard incandescent lamps.

THE ELECTRIC LOCOMOTIVE A COMING NECESSITY.

BY ROBERT S. BALL.

In a recent article which appeared in THE ELECTRICAL ENGINEER, Mr. H. G. Prout seemed to be of the opinion that the time is still remote when electricity will justly claim a share as an agent of motive power on our interurban lines. His reasons were, that the first cost of an electric road would be too far in excess of its steam competitor to justify its adoption, and furthermore that an electric locomotive had not yet been built that could outrun the steam engine. Both of these statements are certainly true, but let us hope that in the near future an electric locomotive will be designed and built which will outclass its rival in speed. This I feel sure is not as difficult a problem as some would lead us to suppose, and if we are to make engines of either type to pull trains at a higher speed than at present I contend that the electric locomotive will be selected for that duty.

As long as we accept present conditions and hope for nothing better in the way of increased speed of travel between our cities, then undoubtedly the electric locomotive for such service, will never be put to the the test. If however, the future demands quicker train service and higher rates are fixed to offset the interest on the first cost of an electric system, it will not be long before engineers will overcome the problems in designing an electric engine to meet the requirements.

The steam locomotive has, as far as speed is concerned, almost, if not quite, reached its limit. Better results in economy of fuel and efficiency as a converter of thermal into mechanical energy can be expected in the future by compounding, steam jacketing, etc., but with some exceptions, notably that of the famous No. 999, we cannot hope for a decided advance, as far as our present knowledge leads us, in the direction of higher speeds.

Apart from the mechanical difficulties involved in building a locomotive for higher speeds than those we are accustomed to, and in making a more cumbrous machine than that we now have, the effect of such an engine on our track and road bed would alone compel us to look for some other means to gain our ends,

Perfect counter-balancing of our locomotive reciprocating parts has not yet been attained, and each mile we add to the speed brings with it an increased trouble from this source. The electric locomotive, on the other hand, is free from the above serious fault. Instead of heavy side rods, connections, and reciprocating parts all adding to reduce the life of both engine and track, we have a perfectly balanced, comparatively simple and easily controlled machine, and whether we use direct or reduction motors the number of parts subjected to wear and tear is far less in this type of engine.

The problem really resolves itself into one of commercial expediency. If we are content with our present transit facilities let us lay aside the electric locomotive and continue to use our old type, but if commerce and business demand a quicker inter-urban train service we must cut loose from steam which has served us so long, and resort to electricity to supply our wants. The demand will soon produce the necessary locomotive, and if the time which is now spent in trying to improve our steam locomotives were directed into the new channel all the apparent mechanical difficulties would vanish. Let us hope this day is not far distant.

"HAVING FUN WITH THE MOTORMAN."

The Thompsonville, Conn., *Press* records the following incident:—A motorman on the electric road had a terrible experience the other night. He was rushing his car along at a high rate of speed through a lonely part of the road when he saw the form of a man lying across the rails. He put on the brake and switched off the lever that regulates the current, but it was too late. There was a jar and the body was under the wheels. The passengers knew an accident had occurred and the women shrieked. When the car stopped the motorman sank down in his box overcome by the shock. The conductor ran back and found that the corpse was a dummy that some practical joker had placed on the rails. The conductor had to run the car the rest of the way to Windsor.

INSURANCE WAR ON THE TROLLEY IN CHICAGO.

By a practically unanimous voice the underwriters of Chicago have adopted resolutions protesting against the introduction of the trolley system in the business centre, denouncing it as a menace to life and property and declaring in favor of an increased rate of insurance upon all property on downtown streets that may be used for such a system in the future. This action of the insurance men is said to be the beginning of a determined fight against any further encroachment upon the business district by the trolley. The aid of the Mayor and Common Council is to be solicited in the warfare against the overhead wires.

TROLLEY COMPETITION TELLS AROUND PITTSBURGH.

The effects of the trolley car competition between Pittsburgh and Carnegie and intermediate points is already noticeable on Panhandle suburban trains. The electric cars are being well patronized, and this fact is alone sufficient proof that the steam road must be losing patronage. The Panhandle trainmen admit a considerable falling off in traffic from Idlewood into the city, and the decline is particularly noticeable at Carnegie, where the electric cars run past the doors of hundreds of people who formerly had to walk to the railway station when they desired to take a trip to the city.

A BIG DETROIT RAILWAY MORTGAGE.

The Citizens' Railroad Company of Detroit has filed a $7,000,000 blanket mortgage covering its property to the New York Security and Investment Company. It is a consolidated mortgage and is made to cover all the company's indebtedness and for the continuance of its work of equipping the lines with electricity.

CHICAGO AND NORTHERN PACIFIC TO "ELECTRIFY."

The Chicago & Northern Pacific has decided to equip Chicago suburban service of the Co.'s lines with electricity. If permits which the Chicago & Northern Pacific desire are granted promptly change of motive power will be made on its suburban branches within 90 days.

TROLLEY PARTIES IN PHILADELPHIA.

The Philadelphia local papers say that the trolley parties are reviving and promise to put all former attempts in this line in the shade. There is a noticeable absence of noise in those that have been perpetrated so far this summer. Instead of the objectionable blowing of horns and the ringing of bells there is a great singing of alleged popular songs, which is, perhaps, even a worse offense, although not a punishable one. The cars are decorated with small American flags and bunting, and illuminated with small electric lights, that are scattered all around the cars, both inside and out. The brightness of the lights is a means of attracting crowds of people, who cheer the trolleyites to the echo. Judging from present indications the trolley parties promise to be more the go than last year, and the "trolleyosis wards" in the hospitals for the incurably insane will probably be taxed to their utmost extent.

LETTERS TO THE EDITOR.

THE MERIT OF THE "ENGINEER" DATA SHEETS.

Permit me as an electrician to tender my thanks to THE ELECTRICAL ENGINEER for the new work which it has just begun under the name of data sheets,—which, as you infer, will certainly be very highly appreciated by the profession.

I have spent much time and attention for a considerable period past in the vain attempt to procure an ideal pocket-book,—one which should contain exactly what I want, only what I want, and so arranged that I should be able to turn to it quickly when wanted. Any one else who may have made a similar search has no doubt met with a similar result. Of all the mechanical, electrical and general engineering pocket-books extant—and their name is legion—I have found but two or three which even, I will not say approximate my ideal, but can be of any practical assistance worth mentioning outside of tables of logarithms and trigonometrics.

The fact is, that it would be unreasonable to expect such a want to be filled through the medium of any bound volume, which to obtain sufficient sales to pay for itself must necessarily contain a sufficient quantity and variety of matter to satisfy any one of the vast number of occupations included under and connected with the general titles of engineer and electrician. A skilled engineer doesn't want his notes cumbered with an exposition of Ohm's law and examples in arithmetic, while conversely the "practical man" has no use whatever for the calculus and many formulae indispensable to others. Again, storage batteries, alternating currents and telegraphy have little in common, yet men engaged in each of these departments have to carry around with them full accounts of them all, or else only such vague and general data in his own line as can be of little assistance to him.

Nevertheless I would not entirely exonerate the authors from the charge of not doing as well as they might under the circumstances. In the first place many pages are often filled with matter whose only excuse for insertion appears to be to fill up space and give purchasers the worth of their money. Probably about one-half of what appears in the average engineer's pocket-book ought to be relegated to the book-shelf, instead of the pocket. More frequently what one does want is *not* to be found, partly because it has been overlooked, by the author, partly because the book is necessarily not up to date. But waiving these objections, I find the very serious faults with *all* pocket-books into which I have yet looked, that they are not properly, or sufficiently, indexed. Information which I *know* to be in a book I am often unable to locate in time of necessity, simply because I cannot think of it under the same heading, general or particular, as the author did. If I should set out to compile a pocket-book, and should profit by my experience, I believe the index would occupy at least ten per cent. of it.

As an illustration of the above remarks, I may say that, in the book I am at present using, not more than 75 of the 685 printed pages (and those nearly all tables) have ever been found useful; the most useful part of the book is that which has been added in pen and ink and cuttings from different sources pasted in, so that the book would serve nearly the same purpose if the original matter were all removed except a few tables.

The method adopted by THE ELECTRICAL ENGINEER is of sufficient flexibility to overcome all these difficulties, and it is to be hoped that it will succeed in overcoming them. I have not yet seen the covers for these sheets, but I trust they are no larger than will conveniently hold 100 to 150 leaves, for this will certainly be all that the average electrician will wish to carry in his pocket. If more sheets are necessary they may be kept in a second cover on the bookshelf.

THE ELECTRICAL ENGINEER deserves much credit for this new effort to please its patrons, and in the interests of all it is to be hoped that it will meet with deserved success. There is only one objection to be raised, namely, that we cannot have our golden eggs all at once, but perhaps we may hope for one every week, if not like those of the historic goose, every day.

GEORGE W. COLLES, JR.

HOBOKEN, N. J., July 2, 1895.

"IT IS WORTH THE MONEY."

A reader in Central Pennsylvania writes: "I am very well pleased with the ENGINEER and hope you will succeed in getting all interested parties to subscribe. It is worth the money."

TELEPHONY.

THE ELECTRIC MESSENGER CO.'S TELEPHONE PLANS FOR PITTSBURGH.

PITTSBURGH is to have an independent telephone system and cheaper rates. These will be furnished by the Electric Messenger Company of Pittsburgh, which secured its charter October 15, 1894, to operate telephone and telegraph lines and exchanges. The capital stock then was $25,000, of which $2,500 was paid in. This amount has since been increased to $500,000 by the board of directors, which includes J. N. Pew, president of the Peoples Natural Gas company, who is president; W. S. Miller, solicitor for the gas company; Joseph T. Colvin, formerly president of the National Bank of Commerce, secretary; Representative William T. Marshall and Samuel G. Pew. Theodore Johnson, treasurer of the Peoples Natural Gas company, is treasurer, and the other stockholders are Thomas Bigelow, R. S. Duffield, superintendent of the Peoples Natural Gas company, and E. O. Emerson, of Titusville. Many other local capitalists have interested themselves in the new company, and Congressman Thomas L. Johnson, of Ohio, has expressed a desire to become financially interested. He, it is understood, with H. H. Weaver, of the Cambria Iron company, will connect the already complete exchange in Johnstown with the lines of the new concern. Capital from the East has also been largely drawn upon to make the company fully equipped to battle with its great rival, the Bell company.

It is the purpose of the company to erect exchanges in, and run its lines through, the counties of Adams, Allegheny, Armstrong, Beaver, Bedford, Bucks, Butler, Cambria, Crawford, Chester, Cumberland, Center, Clearfield, Clarion, Delaware, Dauphin, Erie, Fayette, Franklin, Greene, Huntingdon, Indiana, Juniata, Lancaster, Lebanon, Montgomery, Mifflin, Mercer, Philadelphia, Perry, Schuylkill, Venango, Washington, Westmoreland and York. By taking in these counties almost every city and town in the State of any importance will be touched. An ordinance has already passed the Pittsburgh Councils granting the right to lay lines and erect poles in Pittsburgh, and a similar ordinance is now pending in Allegheny Councils for rights of way on the North side.

Plans are being prepared by Engineer F. H. Carlson, of the Peoples Natural Gas Company, for the conduits in which the lines in the downtown district will be laid, and it is expected active work will start in the construction of these during July. Work in the city, according to ordinances, will have to stop on November 15, so that the line cannot be completed until next year. At the same time work on the main line to Philadelphia will be begun and continued throughout the winter. Charters have also been secured in New York and New Jersey, and the company expects no trouble in crossing Jersey and reaching the metropolis. It is expected the line East will be completed as far as Greensburg by the time the Pittsburg exchange is opened for business. The line will parallel the Pennsylvania railroad, with branch lines to all towns near it. A similar line is to be run parallel to the Allegheny Valley railroad, reaching the rich and populous towns in the Allegheny valley to Buffalo.

Charters have also been secured in Ohio, Indiana and Illinois, and a line will be run to Chicago by way of Cleveland and the large lake cities. It is the intention to begin work on this line almost at the same time the main Eastern artery is started. It is expected all the large cities in these States will be equipped within two years. A branch wire will be run down to Wheeling, including other Ohio valley towns, the company having rights in Western Virginia.

OFFICIAL PRICE OF BELL STOCK.

The Massachusetts commissioner of corporations has fixed the price at which the 10,000 shares American Bell Telephone stock shall be offered to shareholders at 194, and gossip says the market price gravitated to that level. This is equivalent to 198½ dividends on and is a shade under the expected price.

BELL TELEPHONES IN USE.

The gross output of Bell telephones in the month ending June 20 was 16,753, a gain of 7,627; returned, 7,435, an increase of 1,109; net gain in output, 6,518. Since Dec. 20 the net gain in output has been 56,245. There are 685,882 telephones in use.

THE STANDARD TELEPHONE & ELECTRIC CO.

The Standard Telephone & Electric Co., Madison, Wis., makers of the Mildé telephone, in the past ten days have closed contracts at Ishpeming, Mich., with the Marquette County Telephone Co., for 500 instruments; The Western Electric Telephone Co., of Britt, Iowa, for 10,000 instruments; also closed contract with the New York State Reformatory for full plant; with the Pecos Mining Co., Eddy, New Mexico, for a full supply of instruments; and have received orders from Mayfield, Ky., Scottdale, Pa., Peoria, Ill., Hagerstown, Md., Minneapolis, Minn., Rochester, N. Y., Butler, Ohio, Portland, Ore., San Francisco, Cal., and are receiving telegrams and orders daily from all parts of the Union.

TELEPHONE NOTES.

PRESCOTT, ARIZ.—The Prescott Telephone Company has been organized.

VISALIA, CAL.—W. H. Alford will present a petition for a franchise to establish a local telephone system.

CANYON CITY, ORE.—W. D. Fletcher offers $1,000 bonus to any one who will put in a telephone line from that city to Burns.

CHATTANOOGA, TENN.—Clarence C. Duncan is the new manager of the East Tennessee Telephone Company's plant in this city.

FLORENCE, ALA.—Charles Briard, of Augusta, Ga., has been appointed manager of the Florence-Sheffield Telephone Exchange.

AUBURN, MO.—A franchise has been granted to the Auburn Telephone Company.

INDIANAPOLIS, IND.—The Board of Works will not grant a longer franchise than ten years to the Phoenix Telephone Company.

BAY CITY, MICH.—The Anthony Telephone Co. which was granted a franchise in this city, has not accepted it, and the time for its acceptance has expired.

LANCASTER, PA.—A telephone company has been formed with the following officers: President, S. R. Dickey, Oxford; secretary and treasurer, Eli McKissick, Oxford.

ARGENTINE, KAS.—The telephone connection between this city and Rosedale has been completed by the Silver City Telephone Company.

GREAT BARRINGTON, MASS.—A telephone line from the central office at Great Barrington to the post office at Alford will be built at once by the New England Telephone company.

CADILLAC, MICH.—The common council of Cadillac has ordered the Bell Telephone Co., which no longer does business in that place, to remove its poles and wires from the streets.

CARTHAGE, MO.—The Carthage Electric Telephone Company has been formed; capital, $5,000. Incorporators: T. J. Clark, E. C. Clark, G. E. Wheeler and others.

FALL RIVER, MASS.—The Southern Massachusetts Telephone Company has filed an acceptance of its franchise for underground wires. One provision in the grant is to the effect that the city may purchase the conduits.

LANSING, MICH.—If the Lansing Telephone Company can get a franchise a new telephone exchange will be in operation at the capital city shortly after July 1. D. A. Reynolds is at the head of the enterprise.

HARTFORD, WIS.—The Badger State Telephone Company of Hartford has organized and will soon be incorporated. This company has constructed a telephone line from Neosho to Woodland and Iron Ridge, and intends to extend it to other points north.

MCBAIN, MICH.—Wires are being strung from this place to Cadillac, and McBain will soon have telephone connection with Lake City, Lucas and Cadillac. Gillis McBain and O. O. Dunham of this place and H. W. Sill are the proprietors of the new line.

SYRACUSE, N. Y.—A telephone company is being formed by local capitalists to be known as the Mutual Automatic Telephone company, with ample capital already subscribed for the purpose of laying subways and giving the people of the city a perfect service.

NEGAUNEE, MICH.—The new telephone system which will soon be put in at Negaunee and Ishpeming by the Marquette County Telephone Company, will be extended to Palmer. The cost of building the line from Negaunee to Palmer will be paid by Clark Kirkpatrick and it will be his personal property.

ST. LOUIS, MO.—The New Improved Underground Telephone System is to be known as the St. Louis Citizens' Underground Telephone Company. The ordinance granting the new company the right to lay conduits underground has passed a second reading in the Council.

GRAND RAPIDS, MICH.—The new Harrison Telephone Company perfected its organization by electing as officers: President, E. B. Fisher; vice-president, C. F. Rood; secretary, Amos S. Muzzelman; treasurer, James M. Barnett; manager, J. B. Ware. The new company will at once place $30,000 more bonds on the market, and immediately after July 4, will begin building the exchange. It is proposed to reduce rates to $20 and $30 per year for telephone service, the latter for business houses.

MANNINGTON, W. VA.—The Fairmount and Mannington Telephone line has been completed through to Fairmount.

OBERLIN, O.—The Oberlin Telephone company has been formed; capital stock $10,000.

STEUBENVILLE, O.—The Phoenix Telephone company has been granted a franchise at Steubenville by the city council.

DECATUR, ILL.—The entire plant of the Citizens' Mutual telephone company, worth $25,000, together with franchise has been sold to John A. Brown of Decatur, as trustee for a syndicate.

TOPEKA, KAS.—The Topeka Telephone & Electrical company has secured the contract for putting in a telephone system at Manhattan with 100 telephones.

PRESCOTT, ARIZ.—A telephone franchise was unanimously granted Charles F. Hoff of Tucson by the City Council, to put in a Bell telephone system in Prescott.

LOUISIANA, MO.—The La Crosse Lumber Company has arranged to put a telephone line in from Louisiana to Mexico to go through Curryville, Vandalia, Farber, Laddonia and Rush Hill.

MIDDLETOWN, N. Y.—J. E. Iseman, A. B. Wilbur, J. J. Silk, Dr. T. D. Mills, C. S. Mills, and L. S. Stivers, as the new Orange County Telephone Company have been granted permission to erect poles, etc.

SEDALIA, MO.—A new company has applied for a franchise to build and operate a telephone exchange and conduit system in Sedalia. The proposed rate is $2 for business houses and $1.50 for residences.

GRAND RAPIDS, MICH.—The Citizen's Telephone Company has been organized and the following directors chosen: James M. Bennet, S. B. Jenks, C. F. Rood, Amos S. Musselman, C. E. Perkins, E. A. Stowe, W. J. Sturat, Charles R. Sligh, E. Fitzgerald and Phil Graham. The capital stock of the new company is $100,000 of which $60,000 has been paid in.

EDGERTON, IA.—Negotiations are under way for the construction of a telephone line connecting Bonested, in Gregory county, and Wheeler, Edgerton and Bloomington with Armour. The line is to be a continuation of that from Stuart, Neb. to Bonestead and will make a valuable circuit for this section of country.

SHARPTOWN, MD.—The directors of the Bethel, Laurel & Sharptown Telephone Co., which was recently granted a charter, have organized by electing J. Dallis Marvil, of Laurel, Del., president; John M. C. Moore, of Bethel, Del., secretary, and A. W. Robinson, of Sharptown, Md., treasurer. The company will construct a telephone line from Laurel to Bethel and Sharptown.

ALICE, TEX.—A new telephone company has been organized with a capital stock of $10,000, with the following officers: John Wade, president; George Newberry, vice president, and L. G. Collins, secretary and treasurer. The new enterprise will be known as the Alice, Wade City and Corpus Christi Telephone Company.

HENDERSON, KY.—Articles of incorporation of the Henderson Harrison Telephone Co. have been filed. The capital stock is stated as $15,000 in shares of $100 each. The incorporators are Montgomery Merritt, W. S. Johnson, O. W. Rash, S. K. Sneed, James E. Rankin, Chas. E. Dallam, all of Henderson, and H. K. Cole, of Louisville, Ky.

MILWAUKEE, WIS.—A new schedule of telephone rates has gone into effect in Milwaukee on July 1, and the telephone subscribers will be given a number of concessions. The principal concession is the reduction of the standard rate of $90 a year on the basis of 1,000 calls, within a radius of three-quarters of a mile from the central telephone exchange, to $75 a year.

LINCOLN, ILL.—A new organization to be known as the Logan County Telephone Company, the controlling spirits being E. D. Engart, of Lincoln, and J. H. Snyder, of Mt. Pulaski, have closed a contract with the Lincoln Mutual Telephone Company under the terms of which a line is to be built from this city to Mt. Pulaski within three months.

OXFORD, PA.—The proposed telephone line to extend along the L. O. & S. R. R. from Oxford to Peach Bottom will be built in the near future. The following officers and directors were elected at a meeting held last week: President, S. R. Dickey; Secretary and Treasurer, Eli McKissick: Directors, E. B. Patterson, S. R. Dickey, B. S. Patterson, E. L. McSparran, J. K. Fairlamb, W. C. Wood, J. M. Shawalter, Eli McKissick and J. L. Walker.

BARBERTON, O.—A franchise has been granted to the Portage Telephone Company and another to B. G. Holloway. Both were given the right to own, operate and maintain a telephone system in the village of Barberton. Now it has been announced that still another telephone company has come into existence, and is known as the Magic City Telephone Company. It has been incorporated by business men.

LEGAL NOTES.

TAXATION OF THE TELEGRAPH.—THE WESTERN UNION'S SUIT AGAINST THE STATE OF INDIANA.

The case of the Western Union Telegraph Company against the various county auditors and county treasurers of the state of Indiana has been filed in the United States Supreme Court for docketing. It comes from the Supreme Court of Indiana on a motion for a writ of error. The case involves the constitutionality of the state law of 1893 providing for an extra tax on telegraph, telephone, sleeping-car, and express companies. The Western Union Company alleges that the law did not pass the Senate until after the expiration of the constitutional limit of the time of its session and that the valuation of its property as a basis for state taxes as fixed by the state board was exorbitant, amounting to $357 per mile, or a total of $3,297,652 for the entire state, exclusive of real estate, machinery, etc., subject to local taxation. The company asserts that $686,196 would be a fair valuation. It appears that the valuation fixed by the state board was made upon the basis of the New York quotation of Western Union stock, which the company contends was in all respects unfair and inequitable. The company asks to have the county officers enjoined from the execution of the law.

LOUISIANA ELECTRIC LIGHT CO. NOT TO HAVE A RECEIVER.

Judge Pardee of the U. S. circuit court, New Orleans, has rendered a decision in the case of the United Electrical Securities company; the New York Loan and Trust company and the New Orleans Traction Company against the Louisiana Electric Light Company for the appointment of a receiver to protect the property from being wasted.

The court refused to appoint the receiver, declaring the Louisiana Electric Light Company not insolvent, but issued an injunction prohibiting the officers of the company from transferring or disposing of stock, or from doing aught else than managing the affairs of the corporation until February, 1896, when there will be an election of a new board of directors.

TESLA PATENT LITIGATION.

The Suburban Electric Company of Philadelphia has filed an answer in the United States Circuit Court to the suit brought against it by the Westinghouse Electric and Manufacturing Co. and Tesla Electric Co. for alleged infringement on various patents. The Suburban Co. denies having made infringement as alleged, and claims that the patents of the complainants for electro-magnetic motors are void because the alleged inventions and improvements and all the substantial and material parts thereof were disclosed and well-known in the art long prior to any alleged inventions held by the complainants.

SOCIETY AND CLUB NOTES.

ELECTRICAL SUPPLY DEALERS IN BUFFALO ASSOCIATE.

The electrical supply dealers and contractors of Buffalo have organized an association, with the following membership: F. P. Jones & Company, the F. P. Little Electrical Company, C. & S. Company, Buffalo Electric Company, Jaynes Electrical Company, W. A. Fenn, American Electric Supply Company, Theabaud & Churchill, T. H. Flach & Son, Herman L. Peters. The officers are: F. P. Jones, president; Leon L. Miller, vice-president; W. C. Jaynes, treasurer; Wells Dygert, secretary.

MARRIED.

ELECTRICAL DISPLAY AT THE BENALLACK-ANTHONY WEDDING.

The wedding of Mr. Wm. T. Benallack, and Miss Hettie Laurine Anthony was solemnized at the residence of the bride's mother, Mrs. L. M. Anthony, Detroit, June 19. Mr. Benallack has for some time held the position of Electrical Inspector for the Michigan Inspection Bureau of Detroit. A special feature of the decorations was the electrical display arranged by Messrs. Hartwig & Miller of the American Electric Co. and Mr. E. Phillips of the Peninsular Elec. Lt. & Power Co., as a compliment to Mr. Benallack, and which consisted chiefly of tiny colored miniature electric lamps placed in floral set pieces, and among the palms, &c. Numerous beautiful and costly presents were received from the friends of the young couple, among which was a silver water service presented by the fellow employees of Mr. Benallack in the Michigan Inspection Bureau.

Reports of Companies.

ANNUAL REPORT OF THE WESTINGHOUSE ELECTRIC & MFG. CO.

The annual report of the Westinghouse Co. was distributed to the stockholders last week. It opens with a reference to the fine new shops at East Pittsburgh, illustrated in these pages some months ago, and mentions the fact that the company now has room there for between 4,000 and 5,000 men, while some 20 acres are still available for extensions. Stockholders are invited to inspect the place on July 17, when the annual meeting will be held and when special railway arrangements are to be made.

Deducting expenses of removal, the net profit shown for the year is $711,909, which is considered excellent in view of the various adverse conditions prevailing through the year.

For six years the company has been interested in the United Electric Light and Power Company, of New York, and the Brush Electric Company, of Baltimore. In the last year both of these companies have carried through financial plans which have put them on a prosperous business basis, and have given a large increase to the value of their securities, held by the Westinghouse Company. The United Company has acquired almost all the stock of the Brush Illuminating Company and of the United States Illuminating Company, both of New York. It has contracted with the Westinghouse Company for ten complete electrical outfits of 1,000 horse power each, and for all the converters and other needed apparatus, half of these outfits having been used for the World's Fair lighting. On the completion of the above contract, the Westinghouse Company will have in securities of the United Company: First mortgage bonds, $913,000; preferred stock, $550,400, and common stock, $411,700, having already received of this amount, under the terms of the reorganization, for material, unsecured notes, claims, and for a cash subscription of $200,000, first mortgage bonds, $548,000; preferred stock, $187,500, and common stock, $411,700. The company is doing a business of about $800,000 a year from the old plant.

In the reorganization of the Brush Company the Westinghouse Company subscribed for $40,000 first mortgage 5 per cent. bonds, and took in payment for machinery $170,000 first mortgage bonds, making a total holding of $210,000 first mortgage 5 per cent. bonds. The Westinghouse Company also holds 5 060 ($100) shares of the common stock, out of a total of 7,292 shares outstanding. The Brush Company has three of the World's Fair 1,000 horse power engines and generators, and has been supplied with a large amount of other electrical apparatus, and will be hereafter, as will also the United Company, a constant purchaser of Westinghouse apparatus and supplies. The new Baltimore station was recently illustrated in The Electrical Engineer.

As to the World's Fair contract, all the bonds for its execution have been cancelled, and the company has received from President Higginbotham a letter of praise and thanks.

After a full consideration of the subject, the Board of Directors has authorized the issue $1,250,000 ten year 5 per cent. collateral trust bonds, secured by bonds and stocks held by the company, provision being made in the deed of trust for the sale of a portion or all of the securities and for the cancellation of the corresponding amount of the collateral trust bonds secured thereby. It is proposed to fund out of the proceeds of this issue of collateral trust bonds an equal amount of debt, a greater part of which has been created in the building of the new works, the purchase of new machinery, and the outlays in connection with the financial plans of the United and Brush companies.

The Company practically owns the Westinghouse Electric Co. Limited, of England, holding $782,000 preferred and $1,307,400 common out of $2,322,750. It is doing a business at a profit of about 5 per cent. on a valuation of $1,000,000.

Cheerful reference is made to the Company's brilliant successes in litigation respecting the incandescent lamp, the feeder and main case and the Bate refrigerator suits. The long delay in the McKeesport carbon filament appeal to the Supreme Court is interpreted favorably to the claims of the Sawyer-Man patent.

In view of the growing importance of street railway conduit work, notice is drawn to the electro-magnetic system now exhibited at the Company's offices, 120 Broadway, and recently illustrated and described in The Electrical Engineer. The system is now in use in Washington and at East Pittsburg.

Coming to the important subject of the Tesla patents, the report says: "Your Company owns the exclusive right to manufacture and sell apparatus under the patents of Nikola Tesla, covering the use of multiphase alternating currents for power distribution. The rights under these patents are of great value, for developments indicate that it is only by means of Tesla's inventions that elevated and long lines of railways can be successfully operated, and that power can be most economically distributed over wide areas, and throughout workshops. All of the machinery in your Company's new factory at East Pittsburg is driven by Tesla multiphase motors, and in such a successful manner that orders for like apparatus have followed its inspection.

"The 5,000 H. P. generators contracted for by the Niagara Cataract Construction Company have been put in successful operation, and other important installations for power transmission under the Tesla Patents have been made in various parts of the country.

"Recently your Company has fitted a short branch of the Pennsylvania Railroad with ordinary electrical apparatus for the propulsion of standard cars, and the tests have been entirely satisfactory. Your Company is, however, pushing forward the manufacture of multiphase motors under the Tesla Patents for practical tests in running standard cars on elevated roads and long lines, the success of which will be of especial importance, for it will insure to your Company a large amount of trade for which your rivals will have no right to compete.

"Suits under the Tesla Patents are pending against the Stanley Electric Manufacturing Company of Pittsfield, Mass., and the Thomson-Houston Company. In the latter case on application made by attorneys of your Company, the defendants have been limited to the 7th of October within which to close their testimony, it being the intention of counsel to push this and all cases of infringement to a hearing in order that your Company may enjoy the exclusive privileges to which it is entitled.

"While heretofore a very large percentage of the business of the country has been done by means of apparatus using continuous currents, it is now estimated by experts that the percentage will change so that in the near future the bulk of the business will be done by means of alternating current multiphase apparatus, involving the use of Tesla's important inventions."

The balance sheet presented is as follows:

Balance Sheet, March 31st, 1895.

ASSETS:			
Cash in Banks			$302,880 89
Bills receivable			80,183 81
Accounts receivable			2,146,131 10
Material in stock and in process of manufacture (at cost of labor and material)			2,120,227 95
Advances to leased companies			149,588 20
Bonds (par value ($866,206.17)			811,271 38
Stocks (par value 8,656,009.72)			4,092,519 40
Real estate and buildings, Pittsburg			464,403 48
New factory—Land and Buildings		$1,186,750 22	
Less—First Mortgage on land and Buildings (final payment due April 1, 1900)	$400,000 00		
Second Mortgage on land (final payment due April 1, 1896)	115,000 00		
First Mortgage second purchase of land (due July 1, 1899)	59,300 00	574,300 00	
Total			612,450 22
Machinery and tools			1,159,842 44
Miscellaneous			70,292 77
Charters, franchises and patents			4,404,499 45
			$16,314,241 09
LIABILITIES:			
Accounts payable			$403,017 02
Bills payable, issued for merchand'se			379,222 36
Discounted with collateral			1,265,000 00
Contract and Contingent Liabilities:			
Scrip dividend			194,560 00
Stock subscription			18.125 00
Collateral trust bonds			250,000 00
U. S. Elec Ltg. Co.'s 6% 15 year bonds $50,000 payable annually			500,000 00
(Bills receivable under discount $896,972.87.)			
Capital Stock:			
Preferred, 79,865 31 shares		$3,993,265 50	
Assenting, 103,779.02 "		5,188,951 00	
Common, 2,954 "		147,700 00	
			9,329,916 50
(In Treasury 13,266.98 shares Assenting; and 134.69 shares Preferred.)			
Surplus			3,979,400 21
			$16,314,241 09
SURPLUS:			
Surplus balance, March 31st, 1894			$3,822,049 38
Twelve months' net earnings from business	$734,698 85		
From other sources	67,710 37	$802,409 22	
Less expense applicable to moving factories		90,499 54	711,909 68
			$4,533,959 06
Less amounts written off in adjustment of matters pending prior to current year		$78,081 86	
Adjustment and depreciation in current year		133,408 00	211,489 86
			$4,322,519 20
Interest on bonds and mortgages		$57,386 61	
Interest on scrip		11,673 60	
Dividends paid		274,058 78	343,118 99
Surplus balance March 31st, 1895			$3,979,400 21

The Westinghouse Elec. & Mfg. Co. has declared a quarterly dividend of 1¾ per cent. on its preferred stock payable July 1.

A large engine concern write us: "We make a practice of looking over the pointers and suggestions in your paper and in other journals, and we are fairly convinced that there is more valuable news of this kind in The Electrical Engineer than in any other journal which we read."

Trade Notes and Novelties

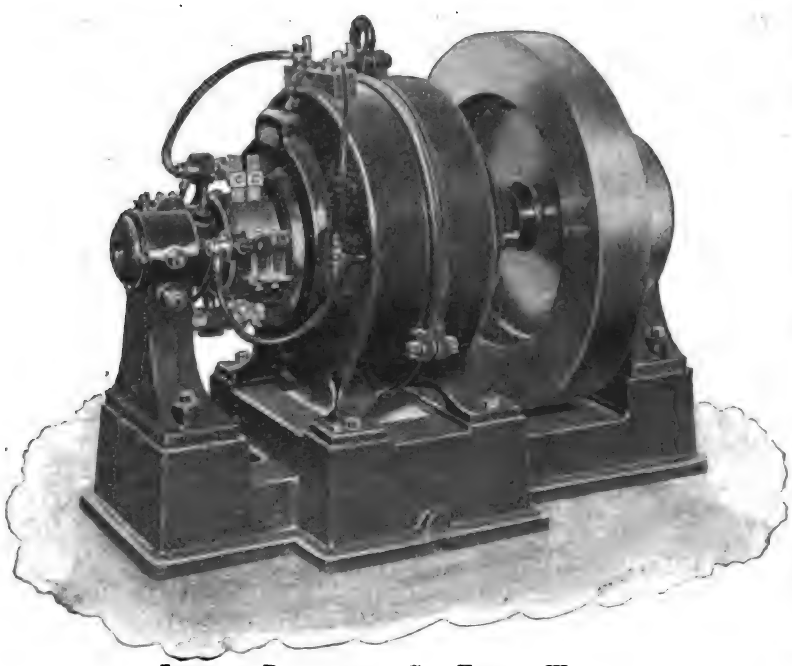
AND MECHANICAL DEPARTMENT.

PELTON WHEELS FOR ELECTRICAL WORK.

The Pelton Water Wheel Company, San Francisco, supplied a few months ago two wheels aggregating 600 H. P. to the Silverton mines in Colorado for running an electric transmission plant, the operation of which has been so satisfactory that a duplicate of the plant has now been ordered. The company have also an order for a 400-H. P. station for the Concheno mine in Mexico, together with an electric light plant for the mine and works. They report also several other orders from Mexico and Central America, which compels them to double up their force, and they are now running their works both night and day.

LUNDELL COMPOUND WOUND GENERATORS APPLIED TO GAS ENGINE SERVICE.

We illustrate a modification of the well-known Lundell generator as constructed for service in isolated lighting when the motive power is furnished by a gas engine. Great improvements have been made in the last few years in gas engines, but up to this date no gas engine above 5 H. P. has been available, it is said, that could be relied upon to operate at uniform speed. In order to provide for absolutely uniform electro-motive force, or, in other words, uniform incandescence of electric lamps in such a plant, the Interior Conduit and Insulation Co. have built a special generator which carries in addition to the belt pulley, a fly wheel of heavy rim weight. In this fly-wheel is stored up sufficient energy to compensate for the slight inherent irregularities in the speed of the gas engine. It will be observed that extra care has been taken in furnishing substantial pedestals, heavy shaft, and modern self-aligning and self oiling bearings. The efficiency of the dynamos is from 86% for the small machines to 93% for the largest machines.



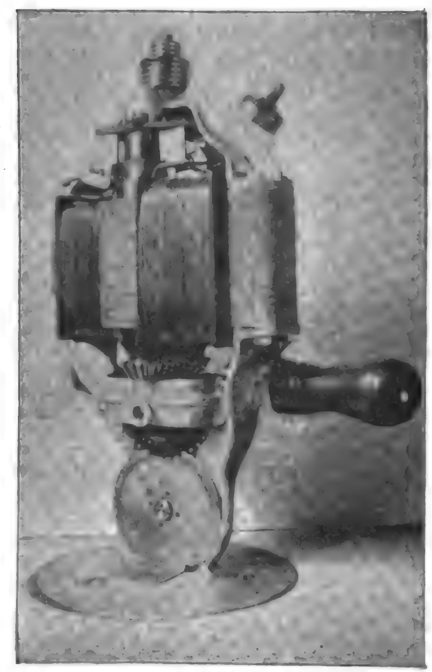
LUNDELL DYNAMO FOR GAS ENGINE WORK.

FAN MOTOR HAIR DRYING.

The *Evening Sun* makes the very sensible remark that fan motors are not yet as well known by the seashore as they ought to be. Indeed, no place can be hotter than a seaside resort with the wind blowing the wrong way or not blowing at all. But the paper suggests the use of fan motors not only for cooling purposes but as a means of drying the hair of women bathers. It says that women are often kept out of the water, not from fear of getting their suits wet but because it takes so long to dry their hair; and it adds that any one who will equip the bathing resorts with fan motors for hair drying will make a very good thing out of it. The practice is already growing up among city hairdressers, who find it very popular with their customers.

ELECTRIC CLOTH CUTTERS.

The Electric Cutter Co., New York, after many experiments, have now had their cloth cutting device on the market for nearly a year. The machine operates on a 110-volt circuit developing ¼ H. P. and is furnished with switch, flexible cord and socket. There are two two-pole motors in each machine, the armatures of which maintain a perpendicular position, each connected by gearings with the circular knife blade below. The motors used by the Cutter Company, have special windings, and in order that the operator may not lose sight of his work, the fields are mounted in somewhat of a rhomboidal shape. The cutter works successfully with four or five inches thickness of cloth, its record being a cutting of 288 separate pieces—or just about double the capacity of the steam cutters now in use in some tailoring establishments. Another advantage is the portability of the machine which may be operated wherever current is found. With the steam cutter the tailor after the pattern is chalked on the top piece of cloth, must carry that cloth to the machine, with consequently some natural disarrangement of the goods, and a delay in subsequent rearrangement; while with the electric cutter, the cloth once marked need not be disturbed, the cutter coming to it. The Cutter Company tried many methods of manufacture, building several types of motors and employing up-and-down as well as circular knives before they hit on the right thing; and the satisfaction caused by the perfected machines assures them that the time spent in experiments was not altogether in vain. Indeed with their experience the Company feel competent to build any size or style of motor for special uses.



ELECTRIC CLOTH CUTTER.

The cutter requires little or no attention. In the event of the knife dulling, a device for sharpening without removing the blade is easily applied.

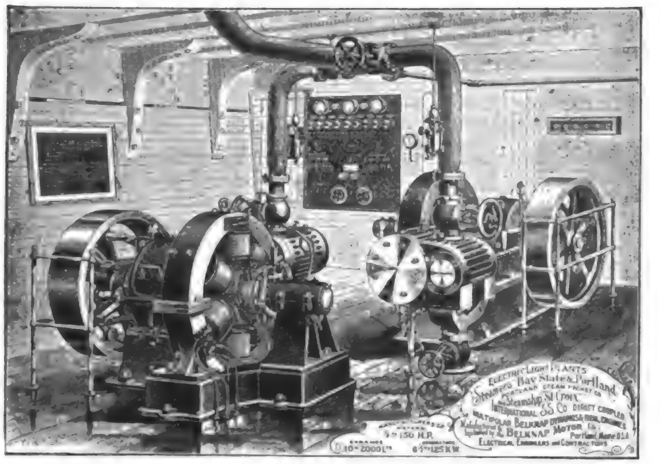
NEW YORK NOTES.

EVERETT W. LITTLE, General Manager of the Interior Conduit & Insulation Co., spent July 1st in Philadelphia, and as a result the new Hotel Walton on Broad street will be wired throughout with the brass armored conduit system. The Hotel Metropole, adjoining, will be a part of the new Hotel Walton and both will be under the same management, that of Stafford & Whittaker of the Imperial of New York. Angus S. Wade is the architect and Harry S. Smith & Co., Ltd., are the electrical contractors.

MR. E. L. BARR, well known to the electrical trade through his old connection with the Canadian General Electric Co. and more recently through his work as traveling salesman for the Wallace Electric Co., Chicago, has been appointed secretary of the latter concern, which is closing out its merchandise business and will hereafter devote itself to acting as western representative for the leading electrical specialties it is now handling.

THE BELKNAP MOTOR CO.'S MARINE PLANTS.

The accompanying illustration represents the electric light plant on the new steamer "Bay State" of the Boston & Portland Line recently installed by the Belknap Motor Company, of Portland, Maine. The engines used are the "Ideal." The dynamos are multipolar slow speed machines of 400 lights capacity each, but either machine will carry the entire load amounting to 540 lights. It has become a general practice to use duplicate plants for marine work so that in case an accident should happen to either engine or dynamo the duplicate machine can do the work. This plant does great credit to the above-named company, and has secured for them the installation of two direct-coupled machines for the



BELKNAP SHIP LIGHTING PLANT.

steamer "Portland," and also for the "St. Croix" which is practically under the same management.

The wiring was done under the direction of Mr. Elmer E. Emmons, one of the most expert workmen in this line in the New England States. Eight main circuits controlled at the switchboard in the dynamo room lead to sixteen different distributing boxes located in different parts of the boat. These distributing boxes have glass fronts secured with lock and key, and are under the control of the steward of the boat.

The fixtures are of the latest design with opalescent globes and shades. The dining saloon is fitted with ground glass globes, which gives this part of the boat a very cheery and pleasing appearance. The freight deck is supplied with guarded fixtures. The boat at night presents a brilliant spectacle being a veritable floating palace and surpassing in all its appointments anything that can be found in eastern waters, the Sound lines alone excepted. The addition of this new boat has been the means of popularizing this line with the best class of the traveling public.

THE AMERICAN MARBLE & TOY MFG. CO.

The American Marble & Toy Mfg. Co., of Akron, Ohio, has recently discovered and secured the control of a natural inexhaustible bed of porcelain clay, specially suited for insulators. The porcelain clay burns a hard, vitreous, glassy, inside body, that resists all moisture, ink, acid, etc. The company now turns out as a specialty electric insulators and tubing. The tubes in white, or dark brown, as desired, are quoted at about one-half the price of ordinary unglazed porcelain.

WESTERN NOTES.

THE WESTERN TELEPHONE CONSTRUCTION Co. report that they are very busy supplying orders for their make of telephones. They have recently received the following contracts from Washington, part of which have been already put up, and are giving perfect satisfaction; Patent Office, 150; Department of Justice, 30; District of Columbia, 200.

THE FRANKLIN ELECTRIC Co. has been awarded the contract to re-construct the electric light plant at Pawnee City, Neb., and to install an 85 horse power engine and a 500 light alternating dynamo together with station apparatus and line construction. The Franklin Co. has also been awarded the contract to re-build the electric light plant at Ossawatomie, Kansas. This plant was destroyed by fire about a year ago and meanwhile the city and inhabitants have been without lights. The work is being rapidly pushed and the lights will be started up there before Aug. 1.

THE FALLS RIVET & MACHINE CO.

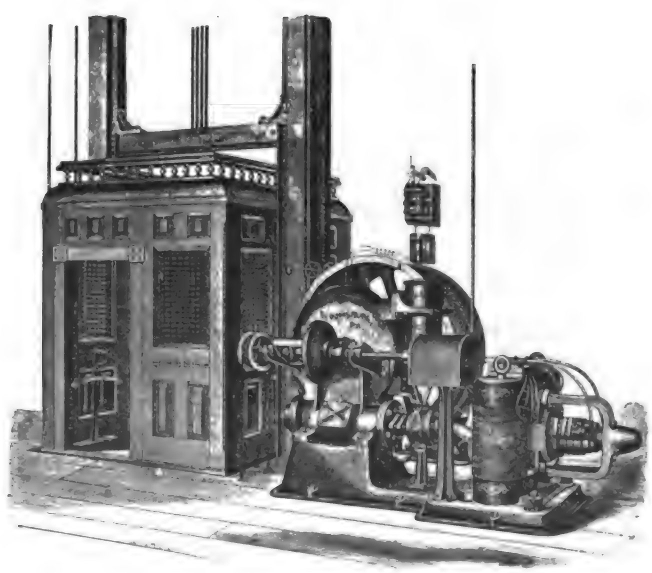
The Falls Rivet & Machine Co. of Cuyahoga Falls, O., write us as follows:—We are pleased to say that our business is picking up somewhat, and are very much elated over an order which we have just received from the Diamond Match Co., of Barberton, Ohio, for a complete outfit of power transmitting machinery for equipping the large factory which they are now erecting at Liverpool, England. We have already equipped several of their factories in this country, and the fact that they favor us with the order for their foreign factory leads us to believe that they are very well pleased with the work which we have furnished them in the past. We think this will be quite a card for us, inasmuch as the material which we are furnishing will go right into the manufacturing district of England, and where a large amount of power transmitting machinery is made.

THE PENN ELECTRIC ELEVATOR.

THE accompanying illustration shows the latest form of electric passenger elevator, built by the Penn Elevator Co., of Bloomsburg, Pa. The motor and machine are mounted on a heavy bed-plate, and the motor is thoroughly insulated from it. The worm and wheel is of the Hindley type, and being cut from solid blanks and running in oil insures the smooth running of the car. The worm is made of steel, and hard metal collars and buttons are provided for taking the thrust at the ends.

The electric brake is so arranged as to release the brake wheel positively when the current is turned on to ascend or descend. Should any accident happen to the main circuit the brake would immediately be applied, thus avoiding any danger of the car running down too fast. The motor and reversing switch are constructed with special attention to secure durability, and the motor is provided with self-adjusting carbon brushes, self-oiling bearings, proper rheostats and safety fuses.

The electric slack cable shifter is a special feature of the machine; the operation is such that in the event of the main cables



THE PENN ELECTRIC ELEVATOR.

becoming slack from any cause (such as the car getting caught on guides while descending), a switch is disconnected by mechanical means and the machine immediately stopped, preventing entanglement of the cables.

The machine is provided with the usual automatic stops for stopping the car at upper and lower landings. The automatic safety clutch, which is connected with the car, is operated by a governor at the top of the hatchway, which operates either in the event of the giving way of the main cables or from any cause which increases the speed of the car beyond the normal.

THE BALL ENGINE CO.'S ORDERS.

The Soldiers' Home at Orting, Wash., has recently purchased an engine for electric light purposes from the Ball Engine Co. of Erie, Pa.

The Salamanca Water Works Co., Salamanca, N. Y., are putting in an electric light plant. Two 175 H. P. tandem compound Ball engines, will furnish the power.

The Norfolk & Ocean View Street Ry. Co., Norfolk, Va., are installing two 125 H. P. Ball tandem compound engines.

THE WHITNEY ELECTRICAL INSTRUMENT CO.'S NEW DIRECT CURRENT SWITCHBOARD INSTRUMENT.

The Whitney Electrical Instrument Co. of Penacook, N. H., has put upon the market a new direct current switchboard instrument of more than average merit. These instruments are handsomely mounted in black enameled iron cases with nickel fronts, are thoroughly dust proof, and are not affected by external

New Whitney Direct Current Switchboard Ammeter.

influences. They will remain constantly in circuit without showing a heating error, and are quite dead beat. Other points of advantage are their accuracy—they are guaranteed within one per cent. of absolute accuracy—and the legibility at a distance, of their scale, which is seven inches in length, with large and clear divisions.

M. R. RODRIGUES.

Mr. Rodrigues, in addition to his "Premier Products" has received many orders for other material, including binding posts, fan guards, brush holders and commutators, one house alone ordering 8,500 of the last named. The result is that larger quarters are necessary and work has been started on a new building which when completed will give Mr. Rodrigues facilities for quick manufacture.

NEW YORK NOTES.

The Stock Market last week was dull owing to the holidays, and almost without any change. Toward the close, however, better tendencies reasserted themselves, and prices became stronger.

Abendroth & Root Manufacturing Company, makers of the Root improved water tube boiler, recently received a cable order for three one hundred and thirteen horse power Root boilers, to be shipped to Johannesburg, South Africa.

Mr. Charles E. Chapin has settled up affairs satisfactorily with creditors on the basis lately agreed to, and is actively pushing business as a manufacturers' agent at 136 Liberty street with bright prospects improving as the times grow better.

Mr. Fred. Reckenzaun, the electrical engineer, is going abroad for rest, and will spend the summer in Switzerland and Austria. He will make note of current progress abroad, and will be back in the Fall to carry out several projects now under consideration.

Mr. R. B. Corey, Havemeyer Building, has just sold 75 incandescent arcs to the parties who have the contract for lighting West Asbury Park. These will be run on a 500 volt circuit 8 in series. Some have already been on trial and give the utmost satisfaction,—leading to this larger order.

Mr. H. L. Brevoort, who died last week was not generally known among electricians, but his work as a patent expert was of a high order. His tastes ran in the direction of electricity, and he made several ingenious improvements and inventions, chiefly in association with Mr. I. L. Roberts.

The Electric Boat Co., of New York has been formed, with offices in the Electrical Exchange, Liberty Street. It will handle the boat described recently in The Electrical Engineer, having a flexible motor-and-propeller shaft. It will make and sell electrical boats and electrical appliances generally. The directors are Frank S. Allen, I. T. McDowell and O. H. Dewitt of this city. One of the boats is now running on Central Park waters.

WESTERN NOTES.

The Bullard Electric Co. has been formed at Chicago to manufacture electrical apparatus, with a capital stock of $25,000. The incorporators are C. W. Bullard, A. S. Bullard and Carl E. Kammeyer.

The Gould Co., 32 North Canal street, Chicago, Ill., has closed a contract with the city of Oregon, Ill., for an electrical pumping plant to consist of one of Goulds triplex power pumps, size 10" x 12" having a capacity of 500 gallons per minute. The pump will be operated by electric motor.

Max A. Berg, Secretary of the Wallace Electric Company, has resigned his position as an officer of that company taking effect July 1st. Mr. Berg will take a well earned rest, and no doubt will become associated with the electrical industries again in the near future.

The McClean Armature Works are very busy at their shop on 197 Canal street on general electrical repair work, and have a very interesting working model of the Baird Electric Conduit Street Railway which they will be pleased to show to all callers who are interested in this very important mode of transportation.

Mr. T. I. Stacy, secretary and treasurer of the Electric Appliance Co. has settled down to work very promptly after his trip to the Rockies, and finds business in a most hopeful and encouraging condition. There is hardly a line in which activity does not prevail, or which does not promise briskness in the Fall.

The Electric Appliance Company have just made some improvements in the manufacture of their excellent black and white "Acme" tape. It has been severely tested in the dryest parts of the country, over considerable periods of time, without showing any intention of hardening or drying out. It is unquestionably a good thing.

The St. Louis Machine Works report among its recent orders for St. Louis Corliss engines the following: Los Angeles, Cal., Electric Co., 400 H P compound; Municipal Electric Co., Decatur, Ill., 350 H. P; Standard Electrical and Gas Works Co., Independence, Ia., 150 H. P.; Union Depot Street Railway Co., St. Louis, 700 H. P. heavy duty; and nearly 1000 H. P. more to various concerns, chiefly in the milling industry.

Field & Hinchman, Detroit.—Last February this firm decided to give up the contracting business and devote themselves entirely to consulting electrical and mechanical engineering. Their business has increased so fast that they found it necessary to move to larger offices and are now at 25-26 Hodges Building. They are at present engaged to superintend the following electric installations: New Valpey Building, Central High School, Masonic Temple, W. H. Frear's Bazaar, Troy, N. Y., D. Scotten & Co.'s factory and residences, and a number of smaller installations. In addition to the above they have recently completed the superintendence of electric light plants in several other buildings.

PHILADELPHIA NOTES.

The Helios Electric Co., in order to secure more room and better facilities for manufacturing, is removing from its present location to Nos. 1225-7-9 Callowhill street, Philadelphia, where all communications should be addressed after July 20, 1895.

NEW ENGLAND NOTES.

The Beacon Lamp Co., L. E. Whicher, treasurer, has absorbed the old Beacon Vacuum Pump and Electrical Co., and has all its assets together with $40,000 in cash for enlarged operations.

The Bernstein Electric Co. of Boston, Henry B. Cram, treasurer, is starting a New York office at room 95, No. 39 Cortlandt street. It will be in charge of Mr. A. L. Fenton, who is already well known as an incandescent lamp representative. He will handle the Bernstein lamps in New York city and vicinity, New York State, Pennsylvania and New Jersey.

Mr. Henry Kaliske will hereafter be known to his many friends as Mr. Henry Sachs, the family having secured legal permission for the change of name. Mr. Sachs has resigned his position, long held, as manager of the Beacon Vacuum Pump & Electrical Co., and his address until further notice will be 21 Harcourt street, Boston.

The Evans Friction Cone Co. existed under a partnership composed of W. A. Russell and G. Frank Evans and has now been dissolved. Mr. Russell is authorized to settle up the affairs of the old concern, while the business will hereafter be carried on by Mr. Evans in his own name and for his own benefit at 85 Water street.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

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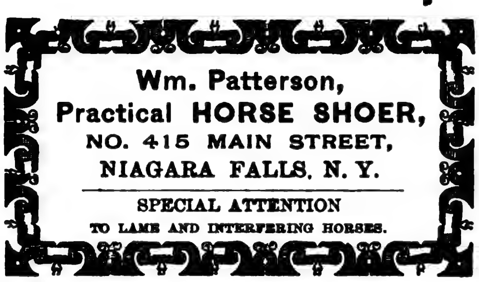
THE BURTON LIQUID ELECTRIC FORGE.

BY

W. W. Ker

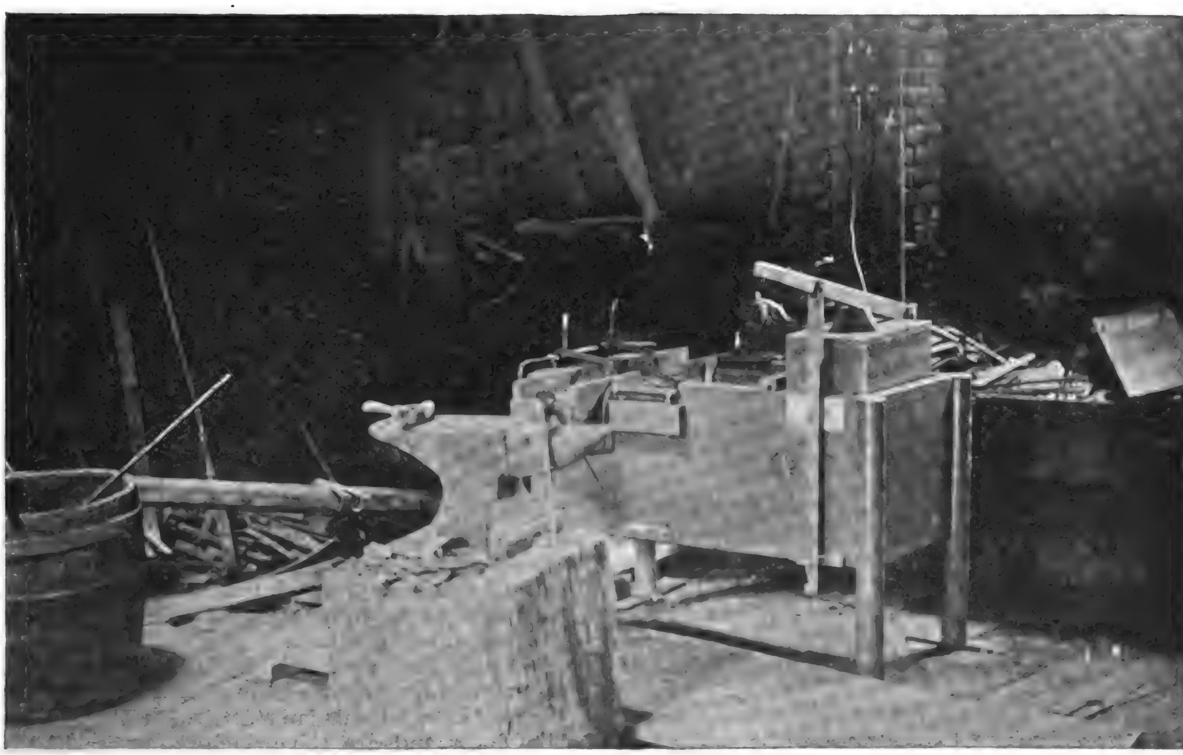


THE decomposition of water by the electric current is an old and well known phenomenon, but the heating of the negative electrode by the ignition of the liberated hydrogen gas has only recently attracted the attention of those interested in electric heating, welding and forging.

The first method of heating a piece of metal by the liquid forge was to connect a lead plate to the positive wire and a pair of tongs to the negative. Then by grasping with the tongs the metal to be heated and immersing it in the vessel containing the positive electrode and a good conducting solution of dilute sulphuric acid or soda, the metal will begin to increase in temperature and if the operation is continued long enough will melt. All the time it is increasing in temperature it is in view of the operator and can be withdrawn when the desired heat is obtained.

The above method of electric heating by complete immersion requires considerable current, and this led Mr. George D. Burton to perfect the method now used, of holding the metal to be heated in contact with the surface of the liquid, and as the hydrogen gas is given off it is ignited directly in contact with the metal which absorbs the heat generated.

The time required to heat iron varies. It takes from eight seconds for a piece of iron one quarter inch square cross-section, to one minute for a piece one inch square ; the latter required 26 amperes at 220 volts which cost, it is claimed, is less than a quarter of a cent for current. The cost of preparing a horseshoe with a coal forge, with coal at $5 per ton, is 5.58 cents ; with the electric forge, and current at 15 cts. per 1,000 watt hours, it is 2.32 cents.



THE BURTON LIQUID ELECTRIC FORGE IN A BLACKSMITHY, NIAGARA FALLS, N. Y.

From the above the economy is readily determined and all that can be said in favor of the electric motor over the steam boiler and engine applies equally well to the electric forge as against the coal forge.

The photograph from which the illustration of Mr. Wm. Patterson's blacksmith shop on Main street, Niagara Falls, N. Y., is taken was made shortly after the adjournment of

the American Institute of Electrical Engineers at Niagara Falls, last month; and the writer is indebted to Mr. Patterson for his time and the current used in the experiments made in order to demonstrate the practical possibilities of the apparatus. A 500 volt current is used derived from one of the Niagara Falls power mill plants.

The forge consists of a rectangular wooden tank with a float controlled by a handle and rack work for raising or lowering the surface of the liquid. The positive wire is attached to the lead plate suspended from the edge of the tank and shown to the left of the float. The negative wire is connected to the three work rests; two of these are used for heating articles held by tongs such as horse shoes, bolts, rivets, etc., and the other for heating particular points on a long bar of iron. This is accomplished by laying it in a trough, shown at the extreme left, on two pieces of movable fire brick, which can be separated to any required distance. The space between the two bricks determines the length of the part of the rod that will be heated, and can be regulated so as to heat a space on the rod from one-fourth of an inch in length up to the full width of the tank.

When the piece of iron is in position and the bricks are adjusted, the clamps are brought in contact with the iron; on depression of the float the solution is brought in contact with the iron; electrolysis takes place and the heat from the burning hydrogen gas is imparted to the iron. By moving the float up and down, the circuit can be made and broken at will, and in an irregular shaped piece of iron this gives the heat a chance to distribute itself throughout its mass.

The solution used in this forge consists of washing soda, 10 lbs.; borax, 1½ lbs; in 45 gallons of water. The burning hydrogen has the color of burning sodium indicating that some of the constituents of the electrolyte are gradually consumed and must be replaced, at a cost of about 10 cents per month.

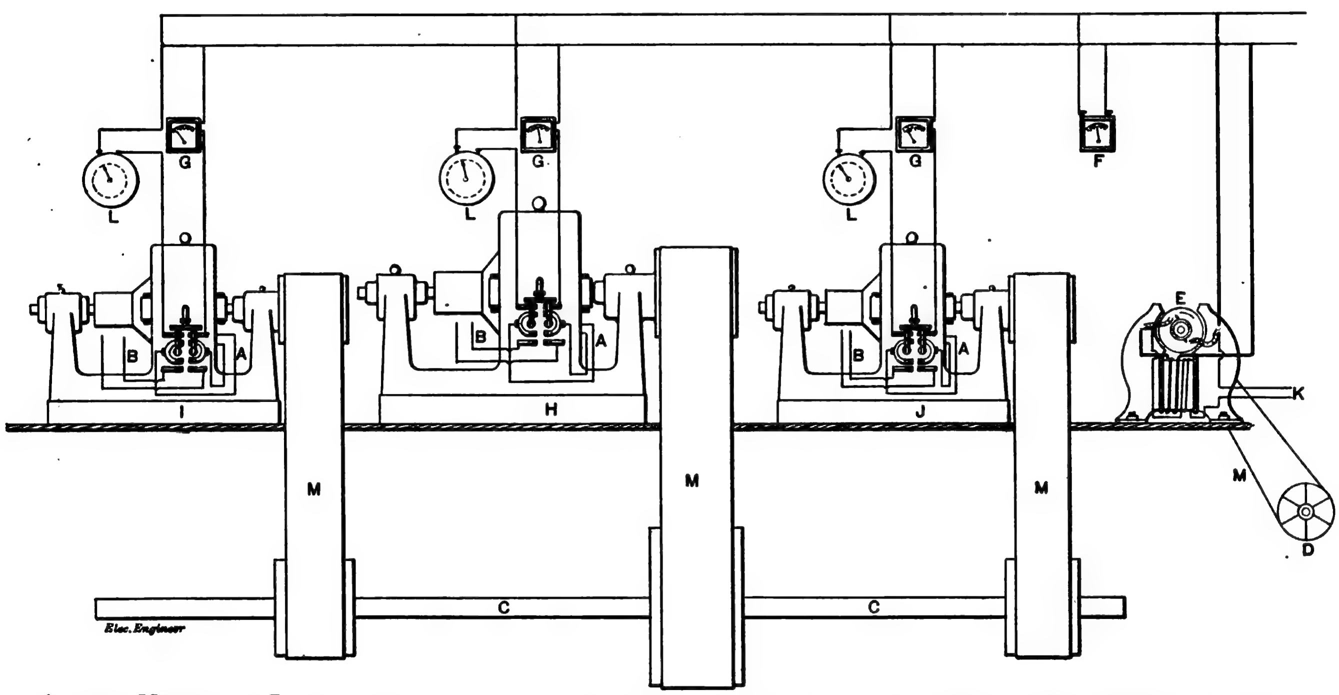
In order to show an improvement in the quality of the iron when using the electric forge, Mr. Patterson heated and hammered a thick piece of iron down to a ⅜ inch rod, and after cooling it in water was able to bend it into a circle of one-half inch radius, and on examination it showed no flaws or cracks.

Another important point in heating with the liquid forge is the absence of scale or oxide on the heated metal; this makes it possible to make a much stronger weld than by the coal forge process.

Mr. Burton, of the United States Electric Forging Co., is now applying this method of heating to the reduction of metals from their ores, and at present is operating a plant in Canada for reducing nickel. The ore is placed in a cradle and the water allowed to come in contact with it to complete the electric circuit.

STEADY VOLTAGE FOR TURBINE DRIVEN RAILWAY GENERATORS.—THE AHEARN METHOD.

The serious difficulties experienced in the operation of the water driven plant of the Ottawa (Canada) Electric Railway were for the most part overcome excepting with reference to the absolute steadiness of voltage, which it was desired should ultimately equal that of a steam driven plant. The speeding up incident to a sudden withdrawal of work on the line was always necessarily followed by increased speed of dynamos and E. M. F., and conversely frequent sudden demands for more power resulted in a "chuck" upon the armatures, more or less violent. This also reduced the strength of fields and largely contributed to the slowing up effect by neutralizing the momentum of the driving machinery, which might otherwise carry the armature over these frequent light demands if the strength of field remained constant.



Ahearn Method of Running Railway Generators by Water Power for Close Regulation, Ottawa, Canada.

During the past winter Mr. T. Ahearn, Managing Director of the Ottawa Electric Railway, and a member of the well known Canadian electrical firm of Ahearn & Soper, who built and are the principal owners of the plant at Ottawa, decided that an independently driven water wheel to operate an independent 500 volt dynamo, the current from which would be employed exclusively for the purpose of exciting the fields of his company's three street railway generators, would remove a multitude of variations of E. M. F. incident to self-excited water-driven dynamos. The necessary work to accomplish this result was completed in the latter part of January last, since which time the plant has been operated with great success upon this plan, and has greatly exceeded expectations.

By reference to the accompanying diagram it will be

seen that an ammeter G is included in each dynamo field circuit A, and placed upon each dynamo is a small double throw switch, so that in the event of an accident to the exciting dynamo or its driving wheel, the several dynamos could be self-excited by throwing the switch on each dynamo, which would connect the armature of each with its own field.

The three Westinghouse generators at Ottawa are, one of 700 H. P. shown at H and two of 400 H. P. shown at I and J, the total exciting current required for all three being less than twenty amperes. C, is the power driving shaft; D, the independent driving shaft for the exciter, and M the driving belts.

Among the many advantages of this system are the following: Steadiness of voltage, removal of the danger of burning out fields by abnormal armature speed, relief to the driving machinery, removal of fields from the line circuit preventing any possible damage to them by lightning or other cause, the prevention of damage to commutators formerly caused by short circuits upon the line throwing open the circuit breakers and short circuiting the current across the commutator. These troubles are now entirely absent. Considerable time is also saved in throwing in dynamos, which is now done without delay after the circuit breakers are reset. This formerly required a very considerable time in synchronizing fields.

The splendid success which has attended the operation of this water plant in Canada should commend it to the serious consideration of the owners of water power plants in America, which are already numerous and will always be increasing in number. And there is no doubt that some of those interested, who may attend the coming convention of the Street Railway Association at Montreal in October next will visit Ottawa to inspect personally this valuable means of removing defects and annoyances incident to the operation of electric railways by water power. Ottawa is but 3½ hours by rail from Montreal and in addition to its being the Capital of the Dominion, is a city of 50,000 live people, who boast of having an incandescent lighting installation of one lamp for each head of population, and an electric railway of thirty miles of track operating forty cars daily, which in the matter of service and equipment is unsurpassed. Ottawa is recognized as electrically of the first importance and also enjoys the proud distinction of having first solved the snow problem, demonstrating that an uninterrupted electric street railway service could be successfully maintained throughout a Canadian winter.

THE LONGEST TELEGRAPH CIRCUIT IN THE WORLD.

BY M. J. CAWLEY.

Believing that the readers of THE ELECTRICAL ENGINEER would be interested in an account of a long distance land line electric telegraphic experiment made in Australia on Sunday, May 26, 1895, I give below details of it and also a rough map showing approximately the positions and distances apart of the cities in circuit when this feat was accomplished.

On the date stated, which was selected so as not to interfere with the ordinary telegraph traffic, the officers of the electric telegraph departments of Western Australia, South Australia, Victoria, New South Wales and Queensland made arrangements for Derby, a town situated on Kings Sound on the northwest coast of Western Australia, to speak with Cape York which is the most northerly point of Queensland and of Australia.

There is no wire between those two towns along the north coast of the continent, the circuit had therefore to be made up as shown in the map.

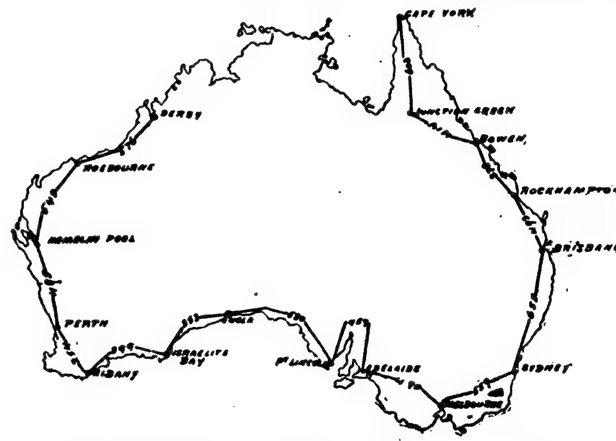
Derby, Roebourne, Hamelin Pool, Perth, Albany, Israelite Bay and Eucla are towns in Western Australia; Port Lincoln and Adelaide are in South Australia; Melbourne in Victoria; Sidney in New South Wales; and Brisbane, Rockhampton, Bowen, Junction Creek and Cape York in Queensland.

There were repeaters at the 14 intermediate offices

Station from	Station to	System.	Distance.
0. Derby	Roebourne	Morse.	576 miles.
1. Roebourne	Hamelin Pool	"	548 "
2. Hamelin Pool	Perth	"	485 "
3. Perth	Albany	Duplex.	254 "
4. Albany	Israelite Bay	"	399 "
5. Israelite Bay	Eucla	"	353 "
6. Eucla	Port Lincoln	"	580 "
7. Port Lincoln	Adelaide	"	459 "
8. Adelaide	Melbourne	Quadruplex.	490 "
9. Melbourne	Sydney	"	559 "
10. Sydney	Brisbane	"	655 "
11. Brisbane	Rockhampton	"	498 "
12. Rockhampton	Bowen	"	378 "
13. Bowen	Junction Creek	Morse.	414 "
14. Junction Creek	Cape York	"	603 "
Total			7,246 miles.

numbered 1 to 14 in the first column and the communication was carried on between Derby and Cape York over this circuit or rather series of circuits covering 7,246 miles at the rate of 11 words a minute. The operator at Cape York leads a solitary existence, not seeing a fellow human being from year's end to year's end.

The distance telegraphed over is the longest combina-



7.246 MILE TELEGRAPH CIRCUIT IN AUSTRALIA.

tion of land lines that has ever been used jointly on the continent of Australia, and some are bold enough to assert that it is the longest distance ever spoken over on any land lines the world over. Perhaps some of the ENGINEER'S readers can say whether this is so or not.

MELBOURNE, AUSTRALIA.

THE DENAYROUSE ELECTRIC GAS BURNER.

QUITE a sensation was created a week or two ago by Professor Vivian Lewes informing the members of the Gas Institute at Edinburgh that a French scientist, M. Denayrouse, had discovered a means of increasing the illuminating power of gas something like fifteen times. Prof. Lewes had been made aware of the discovery during a visit to M. Denayrouse in Paris, and he had obtained permission to experiment with the new method of gas lighting and to make a communication upon the subject to the Edinburgh meeting.

In this invention M. Denayrouse had first been struck with the idea of applying the principle of the blow-pipe to the gas burner. He employs a lamp with a spherical shaped metallic body, and an incandescent mantle. In the body of the lamp is placed a very small dynamo working a ventilator and receiving the current from a couple of small accumulators. The electrical energy required is exceedingly small, and is said to be only about 1-8 volt and

1-10 ampere. This, however, is quite sufficient to force a current of air up through the mantle and to cause the gas to burn with remarkable brilliancy.

According to M. Mellet, the lamp has a density of 35 to 40 carcels, and consumes 7 litres of gas per carcel. Prof. Lewes had, however, been shown a lamp of 80 carcels (about 800 C. P.), and he was convinced that the light was quite as brilliant as an arc lamp.

LITERATURE.

The Telephone Systems of the Continent of Europe. By A. R. Bennett, M. I. E. E. Longmans, Green & Co., London and New York: 1895. pp. XIV., 436, with 169 illustrations. Crown 8vo., price $4.50.

This book is an interesting addition to the literature of telephony, of which, exception being made of Prescott's "Electric Telephone," it forms so far the most imposing volume. It is a book with a history and a book with a purpose, and it is heavily weighted with a bias that the trained telephone man may be trusted to discover for himself. But as there are springing up in this country many telephone men who have yet their training to get, it may be worth while to supply a coefficient of correction with which to establish a fair standard of comparison in the study of Mr. Bennett's racy pages. The avowed object pursued by Mr. Bennett in describing those features of telephony in Continental Europe to which he has devoted his attention is to convince the inhabitants of Great Britain that they pay too much for their telephone service; that that service is generally inferior in point of facilities rendered to the service enjoyed by Austrians, Germans, Frenchmen, Swiss, Swedes, Norwegians and even Spaniards; and that the British Post Office Administration is hopelessly in the dark regarding its obligations to the British public in the telephonic line.

Mr. Bennett is a telephone man of long if somewhat narrow experience. From 1880 to 1890 he occupied, as set forth on his title page, various positions in the English provinces in different English and Scotch Telephone companies, his longest term of service being spent as "General Manager and Chief Engineer in Scotland and the Northwest of England to the National Telephone Company." Shortly after the amalgamation of all the English telephone companies with the National Co., Mr. Bennett became identified with the movement, consequent to the expiry of the British Bell patent, to start telephone exchanges in opposition to those of the National—a movement that began and ended with the establishment of the Mutual Telephone Company at Manchester. Since that time Mr. Bennett has been a consistent and persistent advocate of low telephone rates in England. In 1892 he was general manager and engineer to the New Telephone Company, which proposed to "telephone" London, on a method that flatly disregarded the experience of every large telephone system in the world, at a flat rate of $40. The New Company, fortunately for its shareholders, never went into action as it was taken over by the National while still on the stocks—doubtless on the principle that it was better to purchase an unfinished hull than a wreck. It has been hinted that not all the promoters of the New Company were keenly disappointed that the novelty of the undertaking never got a chance to wear off, but to give Mr. Bennett his due he was not one of these, for he has eminently the courage of his opinions—to such a degree indeed that, as often happens, his courage frequently obscures his vision, as we shall presently show.

The New Company being left in a position to be only new and nothing more, and the management of the Mutual exchange at Manchester (which was sold to the New before the New was sold to the National) not being field enough for Mr. Bennett's abundant energies he has devoted himself for some time past to the task of persuading British municipalities that telephone systems could cheaply, profitably and usefully come within their ever enlarging sphere of influence. His Continental tour and the preparation of the book in which its record is set forth were undertaken in order to provide the municipal authorities and other possible exploiters of telephone systems with impressions seen through Mr. Bennett's rose colored glasses of the cheapness and abundance of telephone facilities on the Continent. We say rose colored because Mr. Bennett makes everything bear in favor of his own contentions that similar cheapness and abundance are British rights; but we think that a pair of green glasses must also have been among Mr. Bennett's traveling equipment, so obvious is the innocence of many of his conclusions and inferences.

So much for the history and the purpose of the book. Now for the execution. Besides an introduction covering 31 pages, there are twenty-six chapters, one for each European country or State, the only omission being the Republic of Andorra. The longest chapters are devoted to Sweden, where there was much to describe, and to Germany, with whose telephone officials Mr. Bennett had a bone to pick, an operation which he performs with characteristically Scotch delight in the operation. These two countries take up about a fifth of the book, while there are several chapters—relating to Bosnia-Herzogovina, Greece, Servia, Montenegro and Turkey—closely resembling the famous one on snakes in Ireland. Most of the chapters are divided systematically into sections as follows: History and Present Position; Service Rendered to the Public; Tariffs; Way-Leaves; Switching Arrangements; Hours of Service; Subscriber's Instruments; Outside Work (local); Outside Work (trunk); Payment of Workmen and Operators, and Statistics. All these subjects Mr. Bennett describes clearly and often in great detail, giving a quantity of valuable and interesting information on the actual status of telephone work on the Continent.

Before proceeding further let us say that as a guide for comparison of the rates in different countries and as an advocate for the application of the charges obtaining in one to the conditions obtaining in another Mr. Bennett is distinctly misleading. In all questions of rates and charges—and whether he loads his gun with a Dutch village or a Norwegian town or the long distance system of a country where there are no long distances, Mr. Bennett fires always at the rates and charges in Great Britain—the book is simply a piece of special pleading. Very well written special pleading no doubt, and probably well calculated to convince the average County Councillor or municipal official. But it would be just as easy for another telephone man, or for Mr. Bennett himself for that matter, to go over the same ground and, by bringing out many and various points that in the present work are ignored, to produce an equally elaborate piece of special pleading on the other side of the case, or better still an impartial description of the conditions that produce the results set forth.

One of the cardinal errors running through the book is the assumption that the purchasing power of money is the same in all countries. Although Mr. Bennett is comparing rates and charges in twenty-one different countries with those in Great Britain he sedulously converts at the closest rate of exchange every money figure into pounds, shillings and pence, down to two decimals of a penny, without offering a word of light on the difference in the cost of living—in the purchasing power of money. It is like supplying a lot of working drawings without scale or measurements. The reader is left to imagine that a pound sterling is the same thing in Sweden, Norway, Belgium, Switzerland, and so on, as it is in Great Britain. Nothing could be more erroneous. The average Swede, Norwegian, Belgian, German or Swiss looks with more respect on a sum equal to a couple of dollars than the average Englishman does on a sovereign, and does about as well with it in purchasing the necessaries of life.

By way of exaggerating this error, which underlies all that is contained in the book bearing on charges, Mr. Bennett ignores, or at any rate fails to give due weight to wide differences in the conditions under which telephone work is done; and he further assumes that all the rates he mentions are profitable. In some cases he even asserts as much in spite of contrary evidence afforded by official reports. The Swiss telephone system, for instance, he says pays, although the official report for 1893 shows a deficit and predicts a larger one for 1894. An impartial writer would scarcely have committed either of these errors and would not have allowed illustrations of extraordinary divergence of conditions and distinctly unprofitable charges to pass through his hands without explanation or comment.

The American reader who studies Mr. Bennett with any idea of posting himself on the main doctrine of the author—the rate question—will be at even a greater disadvantage than his English cousin. It requires no little mental effort, even for one having fair experience in the spending both of pounds, shillings and pence and of dollars and cents, to reduce such sums as £5 11s. 1d., or £9. 14s. 2½d. to anything approaching the equivalent amount in United States currency; and as for amounts like 1.92d, 1.99d, and .096d, most Americans will wonder why people should bother about asking anything at all rather than deal with such decimated charges, though they will marvel at the cheapness of the countries where such prices obtain. Mr. Bennett would have done all his readers a service had he put the rates in the native currencies as well as in sterling. By doing so he would have given a better idea of the real charges—for the unit of money is a moderately good index of its purchasing power—and he would have given Americans a chance, the conversion of francs, florins, marks and even kronor into dollars and cents being simple work. As it is, they will have to read with the assistance of a banker's sterling exchange clerk.

In his introduction Mr. Bennett delivers a broadside to the National Telephone Company and to the British Post Office Administration, and he follows this up with a scattering volley of flings and taunts all through the rest of the book. Indeed, so bitter is Mr. Bennett's invective and so splenetic his comparisons of everything continental with the corresponding British arrangement, or the lack of it, that one is led to imagine the prompting of some motive less disinterested than the abstract desire to see his countrymen revel in the advantages of cheap and abundant telephony. Whatever Mr. Bennett's particular grievance may be it is a pity that he should have let it obtrude itself so obviously and persistently, as the reiterated carping and nagging at British

telephone men and methods are apt to both irritate the reader and cause him to discount the observations and impressions set forth. The gist of the introductory diatribe is that the National Telephone Company is a dropsical monopolist and the Post Office an ostrich-like obstructionist. At the National Company is freely hurled the familiar cry of "water" which every large corporation has to hear, and hears with complacency because no large industry was ever built up on the foundation of a new invention without various unproductive expenditures that the envious and socialistic always class together as "water." The curious thing is that the people who talk most about "water" almost always propose Government or municipal management as the remedy, ignoring that government and municipal administrations are as a general thing the most abominably watered and the worst managed institutions in the world. The policy of the British Post Office towards the telephone has been much that of all the European Governments, vacillating and unpractical. This attitude is the result partly of the Government monopoly of the telegraphs that obtains in every European country and partly of the strange incapacity that Government officials universally show for adopting common sense methods in dealing with new inventions of a commercial nature. If the telephone had been a Maxim gun or a dirigible balloon the Governments of Europe would have tumbled over each others' moneybags in the scramble for it. But being only the foundation of an industry of wide commercial importance they all turned the cold shoulder to it, snubbed it and repressed it. When private corporations (watered of course) showed them what could be done with it they took it up in the usual governmental and thoroughly uncommercial way.

However, with Mr. Bennett's quarrels with the National Company and with the British Post Office the present reviewer has no concern except to point out that the bitterness and aggressiveness with which he conducts them tempers his judgment and weighs down his impressions and conclusions with a strong bias. We should perhaps be falling into almost as great an exaggeration as Mr. Bennett himself is guilty of when he says that the capital of the National Company is three parts water to one part money invested in plant were we to say that the book is one part facts to three parts of a solvent composed of bias, suppression and exaggeration. However, if this review could be as long as the book itself perhaps this qualification might be completely substantiated. In the present case all that the reader can be advised to do is to read the facts and draw his own conclusions as to how the results are arrived at and what the rates set forth really mean by the standard of values of the various countries. In this he gets little assistance from Mr. Bennett except in one or two cases where actual figures of expenses and earnings are published; and from these it is easy to see, by analyzing the figures for salaries, rents, wayleaves and a few other items, that kronor or florins in their native land cut a very different figure from kronor or florins translated into sterling or dollars and considered by the standard of values in the countries where pounds and dollars most freely circulate.

However, the book fortunately contains much interesting matter and many facts besides the enumeration of rates and charges. The descriptions and illustrations of overhead line construction in several Continental countries especially will be something of a revelation to many American telephone managers and engineers who have not yet or have but quite recently got beyond the wooden age. At much of the switchboard and underground work described they will smile—when they do not weep—but the neat, strong, sightly and often highly ornamental iron crossarms and poles, distributing towers and roof fixtures that Mr. Bennett made note of in Holland, Belgium, Switzerland and other countries they cannot fail to admire. Similar practice here would have avoided much of the discredit that has attached to American overhead line construction.

While there are a great many points of difference brought out in the details of the telephone service of the different countries as described by Mr. Bennett, a careful perusal of the book shows a strong family resemblance among them all. In all but a very few places the lines are entirely overhead and constructed with bronze wire, generally of 1.25 mm. (.049 in.) diameter; the switchboard plant, with rare exceptions, is of a type definitely abandoned in America six or seven years ago and in some cases even more antique; while metallic circuits exist on a large scale in only two systems, Paris and Stockholm. The underground work, where special telephone underground construction has been executed, is peculiar. In Paris and Lyons the sewers accommodate the cables; in Vienna gutta percha cables buried solid in wooden troughs are used; in Germany and Switzerland the conduits are iron pipes of large diameter in which a number of cables are drawn in, one on top of the others; practically in Sweden alone has good engineering been done in the underground line, the conduits being of cement with a separate duct for each cable. In Stuttgart there has been put down a small amount of a peculiar style of conduit—a sort of compromise between the large iron pipes of Prussia, Bavaria and Switzerland and the single cable ducts of Sweden and America—formed of inverted cement troughs laid one on top of another, several cables lying side by side as on a shelf.

The only up-to-date switchboards seem to be at Zurich, which has a Western Electric bridging board with self-restoring drops, and at one office in Stockholm equipped with a Swedish adaptation of the same type of board.

The fine points in telephone practice and operation as understood in this country seem to be very generally absent; every variety of eccentricity is shown in the operating methods, the aggregate result being to throw more work and responsibility and to impose many more restrictions on the subscriber than is usual here. This is especially noticeable in the long distance service or, rather, interurban service, for in few of the countries treated of do long distances properly speaking exist. The long distance service is invariably conducted by the Government at non-paying rates, which to a great extent accounts for the many conditions and restrictions and the general inadequacy of the facilities.

In regard to the services rendered to the public there is wide divergence to be noted. In quite a number of important places no night service is given; all exchanges in the German Empire, even Berlin with 29,000 subscribers, are closed at 10 P. M., and several other countries carry out the same practice. In Switzerland, on the other hand, any exchange of over 200 lines has permanent service, and permanent service is the rule in the larger exchanges in Austria, Belgium, Denmark, France, Norway and Sweden. In most of the countries the facility of telephoning telegrams between the subscribers' stations and the telegraph office exists, in some cases without charge, in others subject to a small charge on each telegram, and in still others in consideration of an annual subscription. Mr. Bennett makes a great deal out of what are called on the continent "phonogrammes"—messages telephoned to the central office, written out and delivered like telegrams. This service exists in several countries and although Mr. Bennett almost goes into hysterics over its convenience, beauty and cheapness, he does not stop to point out the very limited application it can have and the slight use actually made of it. In Switzerland, for instance, there were in 1893 about 6,500 "phonogrammes" for nearly 17,000 stations or a trifle over a third of a message per subscriber in the whole year; as evidence of the extraordinary avidity of the general public to use this service there were in the same year just 19 "phonogrammes" sent from public stations in Switzerland!

The long distance service of most of the countries is obviously operated according to the uncommercial policy of Government administrations. The general rule is a single charge for any distance, although charges are graded according to distance in France, Austria, Sweden, Switzerland and one or two other places. How the flat charge without regard to distance works out is shown by Mr. Bennett's own figures, from which it appears that the average earnings per mile of wire of the Belgian long distance lines for 1893 was 31.60 fr. (say $6.32) or as Mr. Bennett would say, £1, 5 s., 3½d—not much more, at English rates, than the cost of maintenance of the wire. If the circuits were long there might be a profit in this, considering what 31.60 fr. represent in Belgium, but the average length of the 75 Belgium trunk lines is only about 40 miles, so the ratio of operating expense to line maintenance is very high. In Switzerland the earnings per mile of wire are about double the Belgian figure, but the average length of the Swiss interurban circuits is only 15 miles, giving a still greater ratio of operating expense to line maintenance.

To sum up, Mr. Bennett's book leaves us with the impression that the telephone systems of the Continent of Europe are generally behind the times as regards line exchange and instrument equipment and quality of service rendered to the public; the only conspicuous exception is Sweden where special causes and circumstances have brought about a special state of affairs. Taking the rates specified in connection with the various conditions of wonderfully cheap labor, supervision, rents, wayleaves and materials, the obsolete and inferior equipment and methods of operating and the frequent occurence of Government administration without regard to commercial considerations, nothing very startling in the way of cheapness is shown.

As a piece of book making the work is well done. Mr. Bennett shows no small amount of literary skill and polish and although it is not his policy to criticize he occasionally becomes mildly humorous at the expense of some of the telephonic eccentricities he encountered; in Prussia alone, however, did he give his critical and humorous powers full play. The illustrations and diagrams are as a rule clear and well executed and form an admirable accompaniment to the text. Almost the only exception is the diagram of the Swedish self-restoring drop (p. 347) which is nearly unintelligible and makes a strange contrast with the clear drawing of the Western Electric self-restoring drop on page 391. The book is thoroughly well printed on good paper, singularly free from typographical errors, and actually bound so that opened flat it will stay open without promptly finding a new place for itself.

W. H.

NIAGARA FALLS real estate appears to be active in these days. The parties who recently bought so largely at Depew have now secured control of about 3000 acres at La Salle.

NOTES ON THE RECONSTRUCTION OF A SMALL CENTRAL STATION PLANT.[1]

BY FRANKLIN L. POPE.

THE financial condition of the smaller central station electric lighting plants throughout the country is at the present time by no means satisfactory, and in too many instances cannot even be truthfully said to be encouraging. A survey of the field shows that very few such plants located in towns having less than 10,000 inhabitants are earning more money than is necessary to meet their operating expenses and to provide for indispensable current repairs. In the state of Massachusetts, in which the operations of all electric lighting companies are by law made a matter of public record, it appears from the latest reports that the aggregate liabilities of the fifty-seven companies operating in that state, including stocks, bonds, and floating indebtedness, amounted on June 30, 1894, in round numbers to $14,000,000, nearly all of which stands charged to construction account. The net earnings for the preceding year were $1,000,000, or about 7.1 per cent. on the total investment: a sum obviously quite insufficient to provide for depreciation and at the same time pay a fair dividend on the capital which has gone into the business. But if half a dozen of the larger plants, in cities like Boston, Lowell, Worcester, Springfield, Lynn and Fall River were excluded from the list, the showing for the smaller plants would be even far worse than it now appears.

Many of these small plants were started at an earlier day than could have been justified by any reasonable estimate of the business then in sight, and now find themselves hampered by inconvenient buildings, and with unsuitable machinery bought at high prices, and encumbered with defective business methods which experience has shown to be wholly inconsistent with the dictates of good judgment.

Having been called upon during the past year to advise the owners of an old plant in reference to certain changes which had been suggested as desirable, and having afterwards been employed in a professional capacity to design the work and superintend its execution, I have thought that some account of what we undertook to do and how we did it, might not be without interest to the members of the Institute.

The Great Barrington (Mass.) Electric Light Company was organized and commenced business in 1888. The population of the district intended to be served was about 3,000, and most of the expected consumers were located within 2,000 feet of the point decided upon for the station. This was built of wood in the most inexpensive manner possible, and was placed alongside the railroad for convenience in receiving coal, although at the same time the danger from fire was materially increased. The original outfit was an Edison 3-wire, equipped with a pair of 250-light 110-volt dynamos, and the company commenced business with 281 lights on contract at $10 per year each, wiring free. The center of distribution was 1,800 feet from the station, necessitating over a ton of copper in the feeders alone. Generally speaking, the plant was well laid out, and well built as things went in those days. The two dynamos were belted to a single 80 H. P. Armington & Sims engine. The original cost of the plant was about $16,000. The following year a Schuyler arc-plant for street-lighting was added, carrying 35 arcs, nominally of 1,500 C. P., which was run from the same engine and boiler. In 1890, the plant was considerably enlarged by the addition of a second arc machine, a Westinghouse 500-light alternator, and a second engine and boiler of the same capacity as the first. An 80 K. W. Westinghouse dynamo of more modern type was afterwards substituted for the original one.

Upon examining the plant last year, I found the Edison machines carrying on Saturday evenings a maximum load of some 450 lights, while three evenings in the week (with the stores closed) it fell to perhaps half that amount. The two Schuyler machines, with an aggregate capacity of 55 to 60 lights were carrying about 38 to 40 or an equivalent of that amount, while the Westinghouse machine was seldom as much as half-loaded, carrying a maximum of possibly 500 lights during three or four months of the summer season, and not much more than one-fourth that amount the remainder of the year. Necessarily, with so many dynamos of different types, and with such a variable, yet small, average output, the consumption of coal was excessive as compared with the light delivered and paid for.

The street lines, according to the usual practice, were of No. 6 B. & S. weather-proof wire; the poles were of cedar, of good size and fitted with pine or spruce cross-arms, with common green glass insulators set upon wooden pins. In consequence of a silly prejudice, which had been fomented amongst the citizens by interested parties against permitting poles to be set in the streets, the wires, in a very great number of instances, had been attached, by cross-arms or brackets, to the trunks of the immense elm trees with which the streets of the town were shaded; a practice which occasioned an enormous loss of current every wet night as well as much irregularity in the performance of the lights. The effect on the trees was by no means salutary, while the appearance was as much worse than that of poles in the streets as could possibly be imagined.

The village of Great Barrington extends for the most part along a single broad thoroughfare for a distance of nearly three miles, and the street-lighting circuits are consequently very straggling. The 1,500 C. P. lamps, which were suspended at intervals of 800 to 1,000 feet, were actually of very little service in illuminating the densely shaded streets.

After a careful consideration of the situation, keeping in view the greatest possible reduction of present and future operating expenses, it was determined the wisest course to pursue would be to consolidate the whole service so that it could be supplied by one dynamo, in place of five underloaded ones. In pursuance of this plan it was decided to adopt the two-phase alternating system, at a maximum pressure of 2,100 volts in the primaries, and 105 volts in the secondaries, with a frequency sufficiently low to permit the advantageous use of induction motors if required. It was furthermore decided to abandon the steam plant, and to make arrangements to utilize some one of the excellent water-powers which were available within practicable distances. Under ordinary circumstances, I should have hesitated to recommend the substitution of water-power for steam as the sole source of power for the operation of an electric lighting plant. Water-power is an invaluable auxiliary, and when conveniently available for use in conjunction with steam, may often be made to save a very large coal bill in the course of a year.

In the present instance, the choice of a water-privilege finally reduced itself to two sites, one in the town itself, within half a mile of the centre of consumption, and the other at Glendale village, seven miles distant, both situated on the Housatonic river.

While negotiations were still pending with the owners of the Glendale privilege and also the one in the village already referred to, overtures were received from a manufacturing company owning a third exceptionally desirable privilege, on the same stream, at an intermediate point considerably nearer than Glendale. This company had only recently completed a new dam, head-gates, raceways, etc., at a very considerable expense, and was willing to lease the complete establishment, including a new McCormick turbine of 325 H. P. and a two-phase Stanley generator of corresponding capacity, at a monthly rental, based upon the actual output as measured in kilowatt hours at the dynamo terminals, provided that a certain minimum monthly consumption was guaranteed. With the same volume of water as at Glendale, the fall at this point was 20 feet, assuring at least 417 H. P. at lowest water, during lighting hours. All the hydraulic apparatus and appointments were of the best possible construction, and well-calculated to ensure absolute permanency of operation.

The minimum rental required was somewhat less than the amount of the coal-bill of the Great Barrington company for the preceding fiscal year, but while the immediate saving in operating expenses was not large, the acceptance of the proposition would place the company in a position to reduce its rates to consumers, for the reason that its output might be very largely increased without materially augmenting its operating expenses. A lease for a term of years was accordingly closed.

In laying out the plant it was determined to bring the main feeders directly to a distributing station in the village, to be used principally as a convenient headquarters for testing the circuits and controlling the street-lighting service. In laying out the transmission line, a surveyor was employed, and a preliminary line was run directly from the power-house to the distributing station. The air-line distance was found to be 5.15 miles. With the assistance of the surveyor, the actual line was then staked out, going directly across country, and keeping as near as circumstances permitted to the transit line. About half the distance, the transit-line was found to so nearly coincide with existing highways, that the consent of the local authorities was obtained to set the poles along the highway location; the remainder of the route lay principally through uncultivated land of little value, so that a comparatively small expenditure was sufficient to secure a release from all claims for land-damages. This enabled the line to be located with long stretches absolutely straight, avoiding all sharp angles; a very important consideration when heavy wires are used. The poles were of selected chestnut with natural butts, usually set five feet in the ground at maximum intervals of 125 feet. The poles were ordinarily 25 feet long and 8 inches thick at the small end. Shorter poles were sometimes used on elevations and longer ones in depressions, in order to equalize the strain as much as possible. The insulators used were of the large double-bell white porcelain type (German government standard), and were imported by us from Berlin. The insulator of the top wire is set upon a malleable iron stem 14 inches long screwed into the top of the pole which is tapered to 5 inches diameter and protected from splitting by driving on a wrought-iron ring. The tapered part of the pole, as well as the top, was given a coating of mineral paint mixed as thick as it could be spread with a brush. The insulator of the second wire is carried on a malleable iron gooseneck, screwed into a 5/8 inch hole bored in the side of the pole, in such position as to bring the wires about 16 inches apart.

1. Abstract of a paper read before the Amer. Inst. Elec. Engs., Niagara Falls, June 26-30, 1895.

Another hole was bored on the opposite side of the pole, intended to take the goose-neck of the third wire at some future time, leaving the same interval between the second and third wires. The porcelain insulators are fixed to their iron supports by a packing of oakum placed between the screw-threads, which serves to prevent any danger of breakage by expansion or contraction. The line-wire is laid in a groove formed in the top of the insulator, except upon the curves and angles, in which case it is tied at the side in a circumferential groove, as is usual in this country.

The German method of tying is quite complex, and unnecessarily strong; in case of undue strain, if anything gives way it had best be the tie wire. We therefore devised a simple tie which was easily and quickly applied, and which has so far served an admirable purpose. We were obliged to string the wires during very cold weather; sometimes as cold as 8 or 10 degrees below zero, and hence it was necessary to strain them very tight. A block and fall and a well-trained horse were used in pulling up, usually six or seven spans of one wire at a time. The hook of the block was always attached to the copper wire, whether bare or insulated, with a chain-knot made of ⅜ inch rope. The feeder-wires were of No. 8 B. & S. soft copper, covered with weather-proof "insulation" along the highway (as a concession to enlightened public opinion), but elsewhere bare. The lengths of wire were joined with McIntire twisted couplings; the unusual strain we had to put upon them occasionally pulled one apart, and this led us, out of abundant caution, to solder them, although this was done for mechanical rather than for electrical reasons. Only two feeder wires have as yet been strung, providing for a single-phase current from one side of the two-phase generator, but it is the intention to run a third feeder hereafter, which will enable two-phase induction motors to be connected to the same distributing system.

A pair of telephone wires of No. 12 steel were strung below the feeder-wires, and these were supported upon small German porcelain insulators on iron goose-necks on opposite sides of the poles. These wires were transposed at intervals of about a mile, in order to eliminate the inductive effects of the alternating current in the feeders. The insulation of the circuit even in the worst of weather is simply faultless.[1]

The system has been planned to deliver the current at the distributing station at a uniform pressure of 2,100 volts. Two distributing centres were fixed upon in the old Edison 3-wire network, and at each of these points a pair of large transformers, having a ratio of 20 : 1, were fixed upon a pole, with their respective primaries in series between a pair of branch feeders from the distributing system, and their secondaries were coupled in series in like manner with the neutral wire between them. None of the consumers on the old Edison system knew when the change had been made to the new service from anything they were able to notice in the behavior of the lights.

The next thing done was to reconstruct the street-lighting system. In place of the 36 arcs of 1500 nominal C. P. formerly in use we substituted 126 incandescent lamps of 50 volts and 32 C. P., placed in Iona fixtures projecting horizontally from the poles 14 feet above the ground. The lights, as a rule, were fixed upon every alternate pole, but in the business centre, the street being broad, they were placed on each side at intervals of about 250 feet, and staggered, so as not to come opposite each other. A Shallenberger shunt cut-out was applied to each lamp. The usual number of lamps in each circuit was 42, although we have since placed, in some cases, as many as 47 in one series without reducing the brilliancy of illumination sufficiently to be noticeable by any one but an expert. One end of each street-lighting circuit is joined to a special feeder leading to the sub-station, where it is connected with the main feeder through a knife-switch. The other end of each lamp-circuit is connected to any conveniently located branch feeder of the regular commercial lighting service. Each lamp-circuit has, or will have, a fuse-block and cut-out enclosed in a weather-proof box at each end, where it joins the opposite feeders. These 32 C. P. lamps, when run at full candle-power, furnish a most satisfactory illumination and give the streets a very attractive appearance. So far as possible each lamp was located with the aid of a transit and level, so as to get them in absolutely straight lines both vertically and horizontally, a precaution which adds materially to the decorative effect.

1 I regret that I am unable to present any actual measurements of the insulation of the line of the Great Barrington company, no opportunity having occurred since the work was completed, of making tests under atmospheric conditions of minimum insulation. Several years ago, however, while engaged in telegraphic service, I made a series of nearly 100 separate tests in rainy and foggy weather, extending over a period of five years, of a set of 10 porcelain insulators of the same make and pattern in every particular as those now on the Great Barrington line, erected on a house-top in the city and therefore much exposed to smoke and dirt. These measurements gave a mean resistance of 28.3 megohms. and a minimum resistance of 19 megohms per insulator. On a metallic circuit therefore, the minimum insulation resistance at each pole would be 38 megohms. On the Great Barrington line of 28,260 feet there are 250 poles and other supports, and hence we may assume that the minimum resistance of the insulation of the circuit as a whole would be 152,000 ohms. The current loss by leakage is found by dividing the mean voltage by the insulation resistance; $\frac{2,200}{152,000} = 0.014$ ampere; an amount too small for serious consideration.

It is admitted by all that the streets of the town are much more satisfactorily lighted by the incandescents than they formerly were by the arc lamps, while the actual cost to the company is considerably less. The new lamps were cut in, one at a time on the old arc wires, jumpers being temporarily placed across the terminals until everything was in readiness to discontine the use of arc machines.

One of the most marked advantages of the series street-lighting system, especially when shunt cut-outs are used, is its great flexibility and convenience. For example, instead of placing from 40 to 45 50-volt lamps in one series, we may use 20 to 23 100-volt lamps, or if an odd number be required, less than is necessary to make up a circuit, the deficit may be supplied by adding extra shunt-boxes in series at any convenient point in the circuit, until the pressure has been reduced to the required point. From time to time, as new lights are added, these spare shunt-boxes are one after another brought into use in connection with them. Sometimes, also, we temporarily install extra street-lights by connecting them in parallel to the secondary mains of the regular commercial service, ultimately transferring them to new series circuits.

It has been found to be desirable to use a lamp of rather low efficiency for the street-lighting service, as there is always danger of leakage and short circuits from wet boughs of trees and other objects getting into contact with the wires, and thus diverting an abnormal current through some portion of a lamp circuit. In such case, a lamp of high efficiency is pretty certain to be burned out, or at least to have its career of usefulness materially abridged. In this plant, the average consumption of energy in the street-lights, including lamps, lines, shunts, and leakage is found to be about 140 watts per lamp of 32 C. P.

Perhaps the most ticklish part of the whole undertaking was the changing over of the Westinghouse system, which was a 1050-volt primary and a 52-volt secondary, running at 16,500 alternations. In accordance with the new plan, it was of course necessary to double the pressure both in the primary and secondary circuits, and to substitute 104-volt for 52-volt lamps throughout. A preliminary test of one of the transformers demonstrated, that which perhaps might have been foreseen from theoretical considerations, viz.: that a dangerous quantity of heat was developed within a few hours when it was used to convert from 2,000 volts down to 100. In order to utilize, so far as possible, the old transformers, and at the same time avoid the above difficulty, various expedients were resorted to. Wherever a group of consumers was located in one neighborhood, a pair of large transformers was installed, with secondary mains extending from 500 to 600 feet in various directions; these transformers being of course placed in series with each other. Scattering consumers as far as practicable, were connected together in small groups, and supplied by a pair of small transformers coupled in the same way. The Westinghouse meters, having been originally constructed for a frequency of 16,500 alternations, ran slow when the frequency was reduced to 8,000. The necessary coefficient for correction of the readings was easily ascertained by experiment, and as fast as possible the meters were fitted with new disks, supplied by the Westinghouse company at a trifling expense, and adapted to the lower frequency.

Of course it will be understood that the reason for resorting to these various shifts and expedients, was merely that we might utililize the old apparatus as far as it could possibly be done, and also that we might carry on the work of reconstruction, for the most part, with the ordinary working force of the establishment.

The following figures are selected from a much larger number obtained by actual measurement of the performance, of the McCormick horizontal double turbine in the testing-flume of the Holyoke Water-power Company.

Head acting on Wheel feet.	Revolutions per minute.	Quantity of water passing through Wheel (cu. ft. per sec.)	Horse-Power.	Per cent. of Efficiency.
16.66	156 25	81.75	124.50	80.99
16.80	155.00	70 79	109.37	81.18
17.02	154.50	63.42	95.86	78 89
17.26	156.75	52.19	73.42	71.95
17.44	152.25	42.55	53.71	63.90

These results are worthy of particular note, for the reason that they show a very high percentage of efficiency maintained through a wide range of variation in the quantity of water passing through the wheel; a most valuable characteristic for electric work.

The turbine carries upon its shaft, a driving-pulley 100 inches in diameter, weighing 11,000 lbs. which serves as a balance-wheel. It is also provided with a Replogle electric governor operated by three cells of gravity battery, which has never failed to do its work quickly and certainly, even under trying conditions.

In carrying out this work, some things have been learned by

experience which may be of use to others called upon to advise or to undertake the construction of similar works, and I will therefore venture to summarize some of my conclusions as follows:

1. In considering the advisability of operating an electric plant by water-power do not on any account, neglect to ascertain from authentic sources of information, just how much water can be depended upon during the low stage in an extra dry year, *for this is the measure of its value for electric work* except when used as an auxiliary to steam. The ordinary estimates of the commercial value of a water-power are only too apt to prove preposterous exaggerations.

2. If rights-of-way or releases of damages can be obtained without too much trouble and expense, it is better to build the feeder line as directly across country as may be, than to follow a highway. The saving in cost of construction will usually be more than enough to pay for the right-of-way, and on such a route there need be no interference from trees, while many inconvenient angles and much trouble in guying and bracing are avoided. Shorter and stouter poles may also be used; in itself a very important consideration.

3. In electric line-construction it is preferable to dispense with cross-arms unless there are more than six wires. The best arrangement is to place one wire on a top pin and the others alternately on the front and back of the pole, at a vertical distance apart of 12 inches. This construction not only costs less than properly braced cross-arms, but is much less conspicuous and therefore much less objectionable in a public street; is less interfered with by trees; and is far more durable. Much trouble is caused by the decay of cross-arms after they have been exposed a few years to the weather; they split at the ends so that the pins come out, and not infrequently break in the middle, thus fouling the wires.

4. In medium-sized towns and cities, especially in shaded streets, the incandescent lamp may be made to give a far better distribution of light for the same money than is possible with the "half-arcs" so extensively used, and is much less troublesome to maintain in good working order. My own experience leads me to think that the lamps ought not to be of less than 24 or more than 32 candle-power. Use lamps of low rather than high efficiency, but run them at full candle-power, or even a trifle above. Good street lights, well arranged, and renewed sufficiently often, are the best possible advertisement for any electric company.

5. Use large transformers as far as practicable, placing the consumers within 500 or 600 feet radius upon secondary mains. We have used both two-wire and three-wire mains. The latter plan is certainly to be recommended when the distance approximates or exceeds 500 feet, but for short distances, as for example, when distributing within a single block at a pressure of 100 volts or more, it is a question whether the gain in cost of copper over the two-wire plan is of sufficient importance to offset the additional complexity.

6. It was found that raising the voltage in the residence district from 1,000 : 50 to 2,000 : 100 greatly improved the uniformity of distribution by lessening the potential drop without entailing any corresponding disadvantages. It would seem to be preferable, on every account, to use the higher pressure.

7. One of the most important minor points in the management of a plant is apt to be too much neglected; the maintenance of the insulation of the wires by promptly replacing all cracked and broken insulators, and by keeping the wires absolutely free from contact with uninsulated objects. The covered wires which lead into the hoods of the street-lamps need to be carefully looked after.

8. Number all the poles with yellow plant applied with a stencil on a black ground; and keep a record book, of the position of each one and its distance by the line from the test-station.

9. In selecting a turbine wheel, consult competent authorities as to the available fall and minimum quantity of water, and when making the purchase do not expect to get a thousand dollar wheel for a hundred dollars. Pay a fair price and insist, not only that the wheel shall be well made in every way, but that it shall be tested by an expert before acceptance. If it does not give an average efficiency of 76 per cent. between half-gate and full-gate, it is not advisable to accept it, inasmuch as you can easily do better, as our own experience proves.

10 I think our experience shows that it is possible to largely increase the net earnings of an old plant without necessarily re-fitting it throughout, but plenty of time should be taken for consideration as well as for execution, in order to secure satisfactory results with a moderate expenditure.

"BUFFALO BLINDNESS."

Had the City of Buffalo been like Chicago, says the Chicago *Herald*, it would have promptly contracted with the Niagara company for the entire output of electrical power, thus making it possible for Buffalo to become one of the chief manufacturing centres on the continent. As it is, the new town of Depew and other points contiguous to the falls are about to witness a marvelous development of new industries in the utilization of the new power.

LETTERS TO THE EDITOR.

THE REAL REASON FOR CONSTANT POTENTIAL ARCS.

In your issue of the 12th of June, 1895, is a short article on "The Rushmore Arc Lamp for Constant Potential Circuits." In it several general statements are made which are in a measure misleading and which it would seem well to correct. In the first place, the general adoption of "the incandescent arc lamp" or arc lamp operating on a constant potential circuit is not due to the greater economy of the constant potential over the constant current system as there stated. So far as the question of economy is concerned, the constant current system is far the most economical whether looked at from the point of view of a complete electrical installation or from that of the amount of energy consumed by the lamps in producing a given amount of light. On the constant current system, the cost of a complete installation for a given number of arc lamps distributed over a given area is much less than for a corresponding number of similar lamps operated on the constant potential system. This statement is patent and goes without saying. So far as the economy in the operation of the lamps is concerned, the direct arc lamp is the most economical for a given amount of light, on account of the great amount of power which has to be wasted in the dead resistance which has to be used with the lamps when operated on a constant potential circuit. Taking the lamps alone and operating them at 45 volts and 7 amperes each, the direct arc lamp would consume 315 watts. The constant potential arc operated upon a 110 volt circuit necessitates two lamps being run in series with an additional dead resistance to cut down the excess of voltage. The total watts consumed under the above conditions is 770 watts for each pair of lamps and rheostat or 630 watts for the lamps and 140 watts waste in the rheostat or 385 watts per lamp, so that so far as economy goes the economy is in favor of the direct current lamp system. The real reason for the general adoption of the arc lamp on constant potential circuits is the fact that either incandescent or arc lamps can be run indiscriminately on the constant potential circuit, thus approximating to the ideal system of distribution, which is of such a character that any form of translating device for light, heat or power may each as an independent unit, be operated upon it. In the second place, it does not follow that because the direct current lamp operates with the cheapest grades of carbons that it gives a satisfactory light as compared with the light given by an arc lamp operating on a constant potential circuit and burning a high grade carbon, nor is it a fact that the constant current arc lamps will keep their adjustment any better than the constant potential arc lamps. The arc lamp running on a constant potential circuit with cheap carbons, will give fully as satisfactory a light, so far as economy and steadiness of operation goes, as the constant current lamp, but this is not satisfactory enough for the purposes for which it is used, so its light giving qualities have been improved and perfected by the use of high grade carbons. A point in the use of high grade carbons which seems to be generally overlooked, is the fact, that besides giving a much better and steadier light than the lower grade carbons, they will also burn nearly twice as long, size for size, as the low grade carbon and although they may cost twice as much, yet the result is nearly the same as regards cost of carbons with the added advantage of vastly increased steadiness of light. The same statement is true of the constant current arc lamp. By burning in them a high grade carbon, most, if not all of their present flickering and spluttering can be done away with and they can be made to run almost as steadily and quietly as the constant potential lamps. A good deal would appear to depend on what is considered a satisfactory light for the conditions under which it is to operate. So far as adjustment in arc lamps go, there are in existence a great many forms of arc lamps and a great variety of adjustments, but there appears to be no reason why, in a well constructed arc lamp, one should keep its adjustment any better than another because it is operated upon a constant current circuit rather than a constant potential circuit. In fact it is more likely to be the other way as arc lamps on constant current circuits are usually subjected to more hard usage than those on the constant potential circuits and as a consequence are more likely to get out of order. Again, as regards the statements that arc lamps operated upon the constant potential circuits are run with much shorter arcs and at less voltage, the implication that they cannot under present conditions be run with longer arcs and at a higher voltage is misleading. It is perfectly possible so to do, and as a matter of fact most of the successful constant potential arc lamps of the day do run at just about the voltage stated, viz. 40 to 45 volts.

There is considerable misapprehension in the public mind as to the conditions under which the constant current and constant potential arc lamps operate. The general impression appears to be that the conditions are so different that the lamps themselves are radically different in construction and operation. This is not so. It is perfectly possible for the same lamp to operate with equal success on either the constant current or the constant potential circuit. The only difference lies in the required safety devices needed to suit the conditions of each circuit, but which

have nothing to do with the operation of the lamp mechanism proper, which may be identically the same in both.

There also appears to be a prevailing belief that the amount of light given by an arc lamp is directly in ratio with the number of watts consumed by the arc. This is not necessarily so. The amount of light depends on the amount of luminous heat generated by the current due to the resistance of the arc and carbons to the passage of the current. The amount of luminosity depends upon the mass of carbon to be heated up at the arc. It is quite possible to have this so large that very little light is obtained although the watts consumed may be the same as in another lamp, working with the same current but which is giving a better light due to the mass of carbon to be heated to luminosity being much less and in proper proportion to give a maximum amount of light for the amount of current used. It is perfectly possible for a lamp using a weaker current than another to give more light than the other, due to this same fact, and one cannot safely or accurately judge of the amount of light which a lamp will give by any statement of the watts which it consumes.

E. R. KNOWLES, E. E.

NEW YORK CITY, July 11, 1895.

TURBINE REGULATION WITH WATER RHEOSTAT IN AN HUNGARIAN MINING PLANT.

A rather difficult problem has had to be solved at the Kremnitz Mine, belonging to the Imperial Hungarian Government. Some time ago it was determined to put down plant for the electrical transmission of power to be utilized for the operation of a winding engine and a stone-breaking machine. The installation was carried out, a turbine being put down for furnishing the necessary motive power. Considerable difficulty was experienced owing to the variation in the load upon the turbine, and the manner in which this obstacle was overcome will shortly be referred to. The winding engine had to lift a net load of 15 cwt. at a speed ranging from 3 ft. to 5 ft. 6 in. per second, and it was required to drive this engine by means of an electric motor and to simultaneously actuate the stone-breaker by a second electric motor. The operation of the former is effected by a motor having a normal performance of 45 horse power. The greatest demand for power on this electric motor is experienced at the moment of taking up the load, and the power required attains various values according to the relative positions of the two ropes, ceasing the instant that the cage reaches the surface, when the electric motor is brought to rest. The regulation of the turbine was effected by the action of a centrifugal regulator. It was found when there was no load upon the generating dynamo—that is, when the electric motor operating the cage and that driving the stone-breaker were at rest—the turbine simply raced, the regulator only coming into action when the demand for power reached 12-horse power. Even at this demand the regulation was not sufficiently precise. Mr. E. Brossmann, one of the Government engineers, under whose supervision the mine is worked, then suggested that the difficulty at periods of no load might be overcome by means of a resistance energized by the generating dynamo. This method, however, was not adopted, and Messrs. Ernst Egger and F. A. Wessel devised a system of inserting an artificial load so as to keep the speed of the turbine practically constant under variable loads, which is a matter of considerable importance in installations of this kind. A liquid resistance was selected on the ground of cheapness and sparklessness on variations in the inserted resistance. The whole arrangement is entirely automatic, and as the load put upon the generator by the working of the winding engine and stone-breaker either varies or entirely ceases, the liquid resistance automatically takes up or absorbs the load whatever it may be, and the turbine and generating dynamo are thus enabled to run at constant load, quite independent of the working of the winding engine and stone-breaker.

ALTERNATE-CURRENT DYNAMO ELECTRIC MACHINES.

At a recent meeting of the Royal Society, Dr. J. Hopkinson and Mr. E. Wilson read a Paper dealing experimentally with the currents induced in the coils and in the cores of the magnets of alternate-current machines by the varying currents in and the varying positions of the armature. It is shown that such currents exist, and that they have the effect of diminishing to a certain extent the electromotive force of the machine when working on resistances as a generator without a corresponding effect upon the phase of the armature current. It is also shown that preventing variations in the coils of the electromagnet does not, in the machine experimented upon, greatly affect the result, and that the effect of introducing copper plates between the magnets and the armature has not a very great effect upon the electromotive force of the armature, the conclusion being that the conductivity of the iron cores is sufficient to produce the main part of the effect. A method of determining the efficiency of alternate current machines is illustrated, and the results of the experiment for this determination are utilized to show that in certain cases of relation of phase of current to phase of electromotive force, the effect of the local currents in the iron cores is to increase, instead of to diminish, the electromotive force of the machine. The large majority of the experiments described were made in the summer of 1893.

PERSONAL.

MERLE J. WIGHTMAN.

Merle J. Wightman.

One of the most active and prominent of the younger engineers engaged in electric railway work is Mr. M. J. Wightman, whose portrait is given herewith. He was born in January, 1865, and first became interested in electrical matters while attending the High School, Taunton, Mass., in 1878-9, at which time he constructed a dynamo of about 1 H. P. capacity, doing all the work on an old fashioned wood turning lathe and covering the wire with a special machine built for the purpose. In 1880 he built a larger dynamo, which was so practical that in 1884, it was used in the Schuyler works at Hartford, Conn., as a motor, to drive the blacksmith's forge. Mr. Wightman's education was finished at the end of 1883, at the Polytechnische Hochschule, Hanover, Germany. He then entered the United States Electric Lighting Co.'s service at Newark, N. J., as an apprentice. Soon after he passed into the employ of the Schuyler Electric Co. at Hartford, and in 1885, in conjunction with Herman Lemp, he was elected chief electrician of the Company. Alone or in association with Mr. Lemp, he obtained about 50 patents in the field of electric lighting, in relation to arc lamps, dynamos, dynamo regulators, series incandescents, &c. In 1887, he joined the Thomson-Houston Co. to develop their electric railway apparatus, and remained with them until 1890, taking an active part in such work. Where so much was done, it is difficult to specify individual performances, but it may be noted that Mr. Wightman developed and put into service the first series multiple controllers. Mr. Wightman had, however, an interest in other work, and was associated with Prof. Elihu Thomson in the development of the single phase alternating motor and the Thomson recording wattmeter.

In 1890, Mr. Wightman left the Thomson-Houston Co. to organize the Wightman Electric Manufacturing Co. of Scranton, Pa., which concern put on the market the first successful single reduction railway motor. In 1891, the company passed into the control of the Thomson-Houston Co., which moved in a mysterious way, once again, its wonders to perform, by practically closing the concern up. Thus left free, Mr. Wigthman became the consulting engineer of the Steel Motor Co. of Cleveland, for whom he designed the "Steel" motor and controller now manufactured by them.

At the present time, Mr. Wightman is the consulting electrician of the Johnson Co. of Johnstown, Pa., where he is engaged in work intended to solve the electric railway conduit problem. He is also interested in several street railway enterprises and is engaged in general electrical engineering work. He is also interested in electrical navigation, in which he has done some ingenious and original work. Mr. Wightman has been a member of the American Institute of Electrical Engineers since 1889.

ELECTRIC DISPERSION.

Mr. P. Drude, in *Wiedemann's Annalen*, describes a method for investigating the relation between the dielectric constant of a substance and the period of the electric waves traversing it, or what may be described as the electric dispersion of the substance. If the dielectric constant decreases as the period increases, there will be normal, if it increases, anomalous dispersion. For alcohol dispersion was found to be normal, and of the same order of magnitude as its optical dispersion. Water showed abnormal dispersion with the large wave-lengths used, whereas ebonite showed no perceptible dispersion.

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CONTENTS.

SUPPLEMENT.

ELECTRIC FREIGHT HAULAGE.

THE unanimity with which the proposition is now accepted that electric motors will soon handle the bulk of the local passenger traffic all over the country, is certainly remarkable. It seems but a few short months ago that the mere ideas of the application of electricity in any shape to existing steam roads was scouted and flouted in practical quarters. We have heard of one steam railway man who only this summer wrote angrily across the statement that his road would try electricity, the word "Bosh!" yet his president and directors have since then all pronounced in favor of the new power. Unless that gentleman, who is thoroughly estimable, shrewd and hard working, changes his mental attitude, he is apt soon to find himself out in the cold. It is a pity that the advance of a new motive power should be regarded as a personal affront by anybody; and we can only remind such stubborn folk of Stephenson's well-worn remark about the "coo" that persisted in standing in front of his new locomotives. As a matter of fact, we find most steam railway men genuinely interested in electrical work, and their feeling is reflected in the journals of their profession, which are discussing the subject on altogether sensible lines, and with no bias in favor of steam simply because it is an agency that their readers happen to be more familiar with. The *Railroad Gazette* sums up our own arguments when it says pithily: "It is the business of the intelligent railroad man to inform himself and that speedily, as to the bearings and limitations of this element" * * * There will be a radical and costly change, a fact which is already pretty well appreciated so far as track and equipment go, but apparently not so far as legal and social rights and obligations are concerned."

The *Gazette* points out that in 1893, the passenger earnings of all the railroads of the United States were about 25 per cent. of the gross total earnings. Mail and express earnings made about 4½ per cent. The earnings from freight were 68½ per cent. These figures vary somewhat by localities, but the percentages hold broadly. It also appears that out of the whole gross earnings only 1.8 per cent. was profit due to the whole passenger business. "It would seem" says the *Gazette* "as if this entire business might be surrendered and no great harm done, but in fact this meagre profit from the passenger business was about one-fourth of the whole sum available for dividends."

That is apparently a reasonable view of a very complicated situation, but the question arises whether it is not also a problem to hold the local freight business. We do not know of any statistics obtainable as to through and local freight business. On the New York Central the local passengers are about 100 times as numerous as the through, but that evidently is no criterion as to freight. On the Pennsylvania, east of Pittsburgh, the foreign freight cars in 1893 made 370,000,000 miles and the home freight cars 436,000,000; which would perhaps indicate that the local freight is in some degree measurable by the home car mileages. Be this as it may, it is a certain fact that a large number of street car lines are now hauling freight (55 in 1894) and that the number is increasing rapidly. The article which we abstract this week from the *Engineering News*

furnishes some interesting data on the subject; while it may be noted that in New Haven and Fair Haven a trolley freight road to handle scores of trains daily is approved, and that in Minneapolis Mr. Lowry proposes to extend his lines to the great grain belt encircling the city and to run grain cars over them, which as he says "can be backed into an elevator and unloaded with less red tape than is now in vogue among railroads." He expects before two years to see the major portion of the grain now handled by Minneapolis carried there by trolley.

It may be inferred, therefore, that the trolley is about to cut deeply into much of the local freight business, which the steam railroads will lose. But the possibility of making the trolley into networks feeders for through steam freight is one that has much to be said in its favor and one to which we expect to see steam railroad managers direct their attention.

SUCCESS OF "THE ELECTRICAL ENGINEER" DATA SHEETS.

With this issue is published another of THE ELECTRICAL ENGINEER Data Sheets. We are glad to say that this new departure has made an immediate,—we might say, unprecedented—success, in the field of electrical journalism. Not only have we received many compliments from old readers and subscribers, but the number of new subscribers, wishful of securing this Data in such a form, is remarkable. The cases for filing the Data Sheets are also in great demand, and appear to be highly appreciated. The publication of the Sheets and the use of the Filing Cases enables an engineer to avail himself of the latest information on the subject, and he has a pocket book that is always up to date. We take this opportunity of thanking the many correspondents who have volunteered their readiness to contribute or verify Data, and to say that their offers of assistance in this important work will be freely availed of.

UNCLE SAM AS ANTI-BELL TELEPHONIST.

WHEN Judge Carpenter handed down his decision declaring the Berliner transmitter patent void, commendations were heard on all sides at the bold stand that had been taken by the Government in contesting the validity of its own grant. The recent decision of the U. S. Court of Appeals has, however, put the Berliner patent into valid standing again, and, unless upset by a suit for infringement brought in the regular way, it is good for the tenure of its original grant of 17 years. The Government's unsuccessful attempt against the Bell Co., would appear not to have dampened its ardor, for we learn that the Interior Department at Washington has just been fitted up with 140 instruments of the Western Telephone Construction Co.'s make, connected to a central switchboard, and that if the system proves successful, as it now promises to do, other Government departments will be similarly equipped. Before accepting the instruments, one of the examiners in the Patent Office investigated the system and upon his recommendation it was installed. The system having been adopted on the recommendation of such an authority it is evident that the Government has been throughly advised as to the responsibility it has assumed in installing a battery telephone system; but it is said that the Interior Department officials have no fear of suits for infringement, although the company supplying the apparatus is under an indemnity bond. It would be interesting to know on what grounds Uncle Sam bases his confidence in being allowed to use a carbon transmitter without molestation, or does he suppose that he will be more successful in the role of defendant in a suit for infringement than in that of complainant in a suit for cancellation of one of his own patents? Then again, is it not a most horrible spectacle to behold Uncle Sam setting such a bad example to his seventy millions of children, sixty-nine and three quarter millions of whom will be prone to do likewise and take refuge under his protecting coat tails. Truly the moralist has here a fine text for a sermon, but we are afraid that it will require something more than moral suasion to induce Uncle Sam to relinquish his own neat little private telephone exchange, or to stop installing others.

HORSELESS VEHICLES.

The recent race of horseless vehicles in France between Paris and Bordeaux was so interesting and successful that the attention of the whole world has been drawn to the subject, and inventors in America are now trying their hand in this field of mechanical traction. To make the effort in some degree remunerative and to stimulate work in this important direction, the Chicago *Times-Herald* has offered the sum of $5,000 to be expended in prizes to winners in a race between Chicago and Milwaukee next November. The terms are as follows :—

First prize—$2,000 and a gold medal, the same being open to competition to the world.

Second prize—$1,500, with a stipulation that in the event the first prize is awarded to a vehicle of foreign invention or manufacture, this prize shall go to the most successful American competitor.

Third prize—$1,000.

Fourth prize—$500.

The third and fourth prizes are open to all competitors, foreign and American.

Details as to the exact date, and as to the regulations, will be published in the near future.

We hope to see some electric carriages entered for this contest and that they will make a better showing than did those competing recently in France, where the petroleum motors proved immeasurably the superior in speed among 100 competitors. The winning petroleum carriage made the round trip of 750 miles at the marvelously high average rate of 16 miles an hour. We do not know of such a record being approached anywhere by electric vehicles, which generally are very heavy and must necessarily be dependent upon the renewal of their batteries, although, as an offset, they are said to be by far the cleanest, coolest and most comfortable. On American roads, no such speed over so long a distance could possibly be made by any vehicle, as our remote rural roads are usually bad beyond description while the French roads everywhere are as a rule superb.

The round trip between Chicago and Milwaukee would probably cover 175 miles, and if the winning vehicle—electric or any other—covers the distance at an average gait of 12 miles an hour it will be doing remarkably well. There is a great field here to be won by mechanical traction, and, as was predicted by the writer several years ago, trolley carriages will in all likelihood occupy a large portion of it.

ELECTRIC TRANSPORTATION DEPARTMENT.

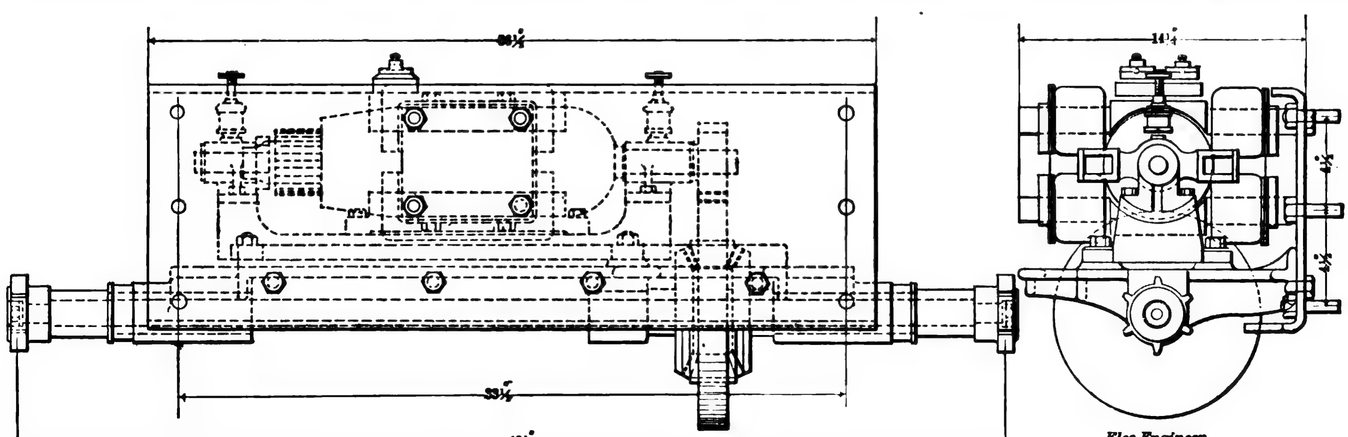
AN ELECTRIC CARRIAGE IN BOSTON.

FOR several weeks past the inhabitants of Boston and its suburbs have witnessed the novel sight of a carriage proceeding along the streets and roads at a good speed without any apparent means of propulsion. The absence of all smoke, puffing, or escape of steam, at once betrays the nature of the propelling power to be electricity.

In designing this electric carriage the result sought for by the owner was not to produce a vehicle of light weight and suitable for short runs only, but rather a carriage of the most substantial construction capable of prolonged runs at various speeds and with a seating capacity of at least six or seven persons. The general design of the carriage is the English brake, as this type seemed to lend itself most readily to the convenient distribution and handling of the batteries which are contained in the body and under the front seat. The top or cover to the body supports the two rear seats and is hinged so that it can be raised and thrown over against the front seat, leaving the cells and all connections accessible for examination or repairs.

The running gear is most substantially built and will stand the heavy strains on rough roads and under heavy loads without any liability of damage to springs or wheels, the latter being provided with ball bearings which reduce the friction very materially.

ELECTRIC ROAD CARRIAGE, BOSTON, MASS.



SIDE AND END ELEVATION OF ELECTRIC MOTOR AND DIFFERENTIAL GEAR OF ELECTRIC CARRIAGE AT BOSTON.

The body is water tight, and acid proof paint has been used very liberally so that under no circumstances can spilling or breakage of a cell cause damage to the motor or connections underneath. The usual fifth wheel and swinging front axle have been discarded and in its stead the axle is jointed just back of the wheels and fitted with heavy crank levers which in turn are geared to the steering shaft. The latter is provided with a bicycle handle, as shown, and a toothed segment with spring latch is also arranged so that by a slight pressure of the operator's foot the front wheels may be locked at any angle.

The battery consists of 44 Chloride cells and has a total capacity of 200 ampere hours with a normal discharge rate of 25 amperes. The cells have been put to most severe tests in hill climbing and heavy roads and have stood up to the mark most admirably. They are arranged in four groups of eleven each and are connected to the motor through a series parallel controller which puts the groups in multiple, series, and multiple series, respectively; this is operated by the lever shown alongside the steering shaft and is locked in the various positions by engaging with a notched arc and spring latch. This arrangement gives three well defined speeds and no rheostat has been found necessary.

The motor is of 4 H. P. capacity, series wound, and the engraving Fig. 2 shows its connection with the running gear. The phosphor

bronze armature pinion engages with a carefully cut intermediate gear the shaft of which is divided and connected through a differential gearing, allowing each half to run at varying speeds when turning corners, etc. This intermediate shaft drives the hind wheels directly by chains on each side, as shown in Fig. 1; the motor and gearing are protected by a light leather casing. A reversing switch for convenience in backing is mounted on the controller arc and is interlocking with it so that the motor cannot be reversed until the controller lever is placed to "off." The carriage can be guided by one hand at any speed, notwithstanding its weight, which is 5,100 lbs.

The speed may be varied from 4 to 14 miles per hour, and all ordinary grades are mounted with ease. Two 10 C. P. lamps furnish light on night runs. The brake is of the usual coach type and has been found sufficient for all purposes.

The electrical work on this novel form of vehicle has been admirably carried out by the Holtzer-Cabot Electric Co. of Boston and the carriage was built by Messrs. Chauncey Thomas & Co. of Boston.

FREIGHT TRAFFIC ON ELECTRIC RAILWAYS[1].

With the rapid increase of suburban and country electric railways, and the practice of carrying freight traffic on such lines, a demand has arisen for cars especially designed for this traffic, and several different types of these cars are shown herewith. The

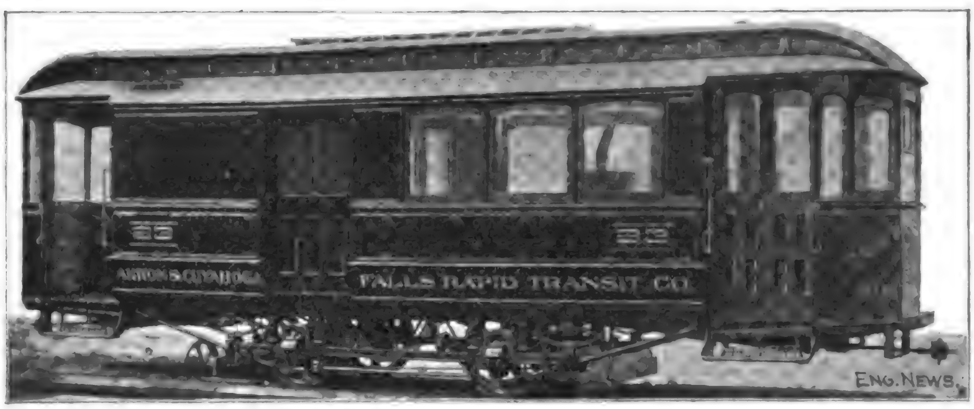


FIG. 1.—COMBINATION CAR, AKRON & CUYAHOGA R. R.

most common type of car for such service is a combination car having a passenger compartment and a freight compartment, as it is only in comparatively few cases that it pays to have cars for freight exclusively. With the combination car, mails, parcels and a limited amount of heavy freight may be carried, thus giving a frequent service without running cars any more frequently than is required for the passenger service.

The combination car shown in Fig. 1 was built by the J. G. Brill Co., of Philadelphia, Pa., for the Akron & Cuyahoga Falls Rapid Transit Ry. The body is 20 ft. long, and is divided into two compartments of equal length, one for passengers and one

FIG. 2.—SPECIAL OPEN FREIGHT CAR, MCKEESPORT ROAD.

for baggage, while the vestibules are of exceptional size, being 5 ft. long. The passenger compartment is handsomely finished in cherry. The baggage compartment is sheathed to the top rail with oil-finished hardwood. The car is mounted on a Brill rigid motor truck, with coiled bearing springs at the axle boxes and elliptical spring buffers at each end of the frame for overcoming vertical oscillation or pitching of the body, while semi-elliptical springs are used under the axle boxes. The car has the Brill adjustable truss, which prevents sagging of the ends.

Larger cars of this type are carried on two four-wheel trucks. An example is a car built at the same works for the Westminister & Vancouver Tramway Co., of Westminister, B. C. This car is 26 ft. long over the body and 33 ft. long over the platforms, which are open. The width is 6 ft. 10 ins. at the sills, and 7 ft. 6 ins. at the belt rails. The baggage compartment is 8 ft. 8 ins. long, and the passenger compartment 17 ft. 4 ins. long, with a seating capacity for 24 persons. This car is carried on two Brill "maximum traction" tracks. The car weighs about 11,050 lbs. the body weighing 5,850 lbs. and the two trucks 5,200 lbs. The J. G. Brill Co. has built about 100 cars for this class of service.

The McKeesport, Duquesne & Wilmerding Ry., which forms a connection between the Pennsylvania R. R. at Wilmerding, Pa., and the manufactories and railways of McKeesport, operates combination cars, box freight cars and open trail cars for carrying vegetables to market.[2] These cars were built by the New Castle Car Mfg. Co., of New Castle, Pa., and one of the open cars is shown in Fig. 2. It is 26 ft. long over the platforms, 18 ft. long over the body, has removable sides 4 ft. high, and is mounted on a McGuire truck. For shipments of heavy freight a box car of 12 tons capacity is used, equipped with two 40 H. P. Westinghouse motors. The car is the same length as the open car, 7 ft. high inside, has sliding doors in the sides and ends, and is carried on a McGuire truck. There is also a train of trucks for hauling lumber, sand, bricks, theatrical scenery, etc. This railway is only 4½ miles long, but it effects a connection over a ridge where no route for an ordinary steam railway is practicable, and the existing main lines form a circuitous and indirect route. Passengers on the Pennsylvania R. R. for McKeesport were formerly compelled to go to Pittsburg, change to the Baltimore & Ohio R. R., and then return to McKeesport, making 29 miles of travel from Wilmerding. The height of the ridge is 1,200 ft., and the electric railway surmounts an elevation of 400 ft., having numerous curves and maximum grades of 11%. This electric line is now the

1. Abstract, from the *Engineering News*, July 11, 1895.

2. This road was described and illustrated in THE ELECTRICAL ENGINEER, Vol. XVIII., No. 324, July 18, 1894.

principal connecting route, and mail and express matter from the Pennsylvania R. R. arrives in McKeesport five hours earlier than formerly, while a day is saved in freight shipments from the East, as McKeesport merchants have their freight shipped to Wilmerding and then transferred to the electric railway. Mail is carried from the Pennsylvania R. R. over this electric line not only for McKeesport, but for transfer to three lines of steam railways centering at McKeesport. The time from Wilmerding station to the McKeesport post office is 40 minutes, and the mail is carried under the regular railway mail contracts, the government paying a certain amount per 100 lbs. per mile. This was the first electric railway with which the Adams Express Co. made a contract, and the express matter is ordinarily carried on the combination baggage and passenger cars, except when the shipments are large enough to require the use of the box car. For this service the railway company is paid monthly at a certain rate per 100 lbs. of matter.

A combination car leaves each end of the line hourly from 6 A. M. to midnight, the trip occupying about 40 minutes. These cars are 20 ft. long, having a 5-ft. compartment for mail and express matter, this compartment having wide, swinging doors. These cars and the ordinary passenger cars are equipped with two 25 H. P. Westinghouse motors. All cars are fitted with track brakes for additional safety on the heavy grades. This brake consists of a shoe between the two wheels. The mail, express and freight traffic is a profitable feature, as it does not interfere with the regular passenger service, and the frequency with which the electric cars are run makes the saving in time specially desirable for mail and express matter. At McKeesport the company has its own wagons to collect and deliver freight. Connection is made at this place with electric lines to Reynoldstown, Duquesne and Homestead, while at Wilmerding connection is made with other electric lines extending to Braddock, Glenwood and Pittsburg, so that there is a continuous electric railway route from McKeesport to Pittsburg, 20 miles. All the line is single track, with turnouts, and the track is laid with 52-lb. T-rails on chestnut ties spaced 36 ins. C. to C. The power house is situated at about the middle of the line. Coal is obtained from a neighboring mine, owned by the company. Taylor, Romine & Scott, of McKeesport, were the engineers of this road, and we are indebted to Mr. James L. Devenney, its general manager, for information concerning it.

A large baggage and freight car is used on the Rockland, Thomaston & Camden Ry., of Rockland, Me.[2] The body is 25 ft. long, 7 ft. wide and 7 ft. high at the centre. The length of platforms is 30 ft., and the distance C. to C. of bolsters 18 ft. 9 ins. The car was built by the Briggs Carriage Co., of Amesbury, Mass., and is carried on two four-wheel Bemis trucks, with a 25 H. P. General Electric motor on each axle.

The West Chester Street Ry. Co., of West Chester, Pa., is another electric line doing a freight business. The company operates as one of its branches a cross-country line five miles long, from West Chester to Lenape, built on land acquired by the company. At Lenape freight transfers are made with the Wilmington & Northern R. R., connecting with the Baltimore & Ohio R. R., and large quantities of local freight are brought from Philadelphia in this way, thus competing with the Pennsylvania R. R. for all store goods coming into the town. The freight traffic is considerable, and is expected in time to pay very well. The line is 5 ft. 2½ ins. gauge, equipped with the Edison system, and has 5 passenger cars, 1 baggage car and 1 gondola car, all built by the J. G. Brill Co., of Philadelphia. The latter cars carry all kinds of freight except live stock. The U. S. mails are carried between West Chester and Lenape for points on the Wilmington & Northern R. R., and the road has a contract with the United States Express Co. to carry all its business to and from West Chester, for which traffic the baggage car is used.

Two cases may be mentioned in which accommodation is provided for special traffic on electric lines, one being the handling of whiskey at Frankfort, Ky., and the other the handling of grain and flour at Spokane, Wash. The Capital Ry., of Frankfort, Ky., does a large business in carrying to the station of the steam railway the barrels of whiskey from large distilleries in the district, and uses for this purpose a large box car, which also carries general freight and supplies for local service, and is used as a locomotive, hauling three loaded box cars between the railway and the distilleries. The car, which was built by the Barney & Smith Co., of Dayton, O., is 28 ft. long over all, 22 ft. 5 ins. long over the body, 8 ft. 4 ins. wide over the sills, 7 ft. 10 ins. high from sills to top of roof, and 10 ft. 8 ins. high from rail to top of roof. The platforms are open. The car is mounted on a pair of four-wheel trucks, with a 25 H. P. motor on each axle, and weighs about 15 tons empty. The line runs through a difficult country and has maximum grades of 8%, with, in one case, a reverse curve on a 7% grade, which, however, the motor car can pass with two or three loaded railway box cars. The track is of 56-lb. T-rails.

The Spokane Street Ry. Co., of Spokane, Wash., hauls wheat and flour between the mills and the railway station, and has displaced the drays formerly used. The city passed an ordinance providing that the charge must not exceed 20 cts. per ton, or 15 cts. per ton each way if the car is loaded both ways; the minimum car load to be 5 tons, and the company to supply current and right of way over its tracks for any cars owned by the mills at a charge not exceeding $2 per car. The first car was built at the railway company's shops, and is of the ordinary type of box car for electric railways, but having enclosed or vestibuled end platforms. It is 20 ft. long over all, and the grain compartment is 12 ft. long, 6 ft. wide and 5 ft. 6 ins. high, with a capacity of 12,000 lbs., or 200 bushels of wheat. The compartment has side openings, fitted with grain doors. The floor is the same height as that of a railway box car, and underneath it is a steel hopper, the floor being hinged so as to uncover the hopper when raised. At the freight station the floor is raised and the car loaded with grain from the main line cars. On reaching the mill the car is run over a chute, the gate of the hopper is opened and the grain is dumped. The floor is then let down to cover the hopper and the car is loaded with bags or barrels of flour to go to the railway station. The car has also been used for carrying and discharging broken stone for macadamizing the streets along the line. It is mounted on a four-wheel Brill truck with 30-in. wheels and 6 ft. 6 ins. wheelbase, and has an Edison double reduction motor on each axle. The line has grades of 4½ and 5½ per cent. and has a curve of 55°.

2. This car was illustrated and described in THE ELECTRICAL ENGINEER, Vol. XV., No. 252, March, 1893.

AIR VS. ELECTRIC BRAKES.

BY H. WELLMAN.

Upon reading the article of Mr. J. C. Henry, in your issue of June 26, regarding air or electric brakes, I am inclined to the belief that the writer is unjustly prejudiced against the air brake. He cites as a possible illustration his trouble in keeping tight pipe joints, piston valves, etc., during experiments conducted some six or seven years ago. This, I should think, is entirely aside from the question and should not be compared with all modern work in this line, as successful air and steam piping is general on all railway coaches and has been for years and the piping of a street railway car for air is not considered at all as difficult engineering.

I fully agree with you in the clause in your editoral under date of May 29, viz., that the air brake on street car lines is as inevitable as it has proved to be on steam roads. The above writer also makes mention of the numerous parts required in an air brake system complete as a braking unit; also of the fact that on most electric cars, there is no room for air pump on car axles. These defects are in my opinion slight and easily overcome, for the reason that for public conveyance and convenience, the stress is for larger and longer cars using double trucks, thereby affording ample room for eccentric air pumps or compressors to be placed on car axles. Air pumps run by a separate motor, as those used on the Intramural World's Fair Road, also the ones used on the Metropolitan Elevated at Chicago, are very successful and run with only a moderate amount of attention. They are very economical and are entirely automatic, keeping a constant air pressure in the reservoir underneath the car. The air compressor designed by Prof. Short, and mention of which is made in his recent paper read before the Cleveland Electric Club, is a very complete machine and contains many meritorious features, as well as economizing space. I fully agree, that it is criminal to operate street cars without *either air or electric brakes*, but certainly am not of the opinion that the days of the air brake are numbered. In fact, I think that the importance of the air-brake on street car lines is just beginning to be appreciated by the street railway fraternity. Taking it all around, there are about as many parts to keep up in repair, in a complete system of electric brakes, as with air brakes, and until the electric brake can successfully hold a car on a heavy grade after stopping, the advocates of the same can hardly hope to compete with the modern air-brake equipment now being very largely installed.

As quoted by Mr. Henry, the ideal electric brake should not depend on the live current, should be as near as possible frictionless, and the retarding force should be proportionate to the speed of the car; provided, of course, that the motor be converted into a *temporary* generator, by changing terminal contacts at the controllers. The electric brake as at present constructed, certainly brings a car to a stop in a very satisfactory and easy manner, but on grades they have to be supplemented by the vigorous use of the hand brake, to hold the car until ready to start; for, as is well known, as soon as the car stops and is at rest, the generating power of the motor is lost and there is (excepting that caused by a slight amount of residual magnetism) no retarding force or adhesion of the magnetic brake gripping the disc on the car axle or wheels.

It seems to me that a low voltage electric brake could be constructed, taking current from a number of cells of accumulators placed under the car seats. These cells need not necessarily be of great number and could be charged from the live current. A combination of this kind would hold a car as successfully on a steep grade as on a level, and with no use whatever being made of the hand brake.

Taking it all around, there would be about the same amount of labor in keeping up a system of electric brakes as of air brakes, and until the electric brake can successfully hold a car on our

steepest grades, the advocates of air can rest easy on their laurels, not mentioning the fact of other advantages arising from having air on cars. An important advantage is the whistle, and especially so in suburban roads and thinly settled districts; other advantages could be mentioned, such as cleaning snow from trolleys in winter and for the thorough cleaning and blowing out of motors and controllers of all copper and carbon dust, cotton, etc., thereby saving an immense amount of labor and lessening the evils and expense of burnouts so prevalent with dirty and dusty electrical apparatus. It seems to me that the braking of all cars has resolved itself into one or the other of the very small evils, namely, either the storing of air underneath cars in reservoirs or the storing of electricity in accumulators placed on cars, thereby holding "*on tap*" the necessary braking force. The future will undoubtedly bring forth numerous improvements on both air and electric brakes and I am fully convinced that important inventions in this line will fully keep pace with the growing and increasing demand for electric cars of all kinds, both for our street and our trunk line railroads.

EXPERIMENTING WITH THE BALTIMORE TUNNEL TROLLEY.

A special dispatch from Baltimore, of July 8, says:—The large electric locomotive with which the Baltimore and Ohio Railroad Company is experimenting in its tunnel under this city failed today to move a train of twenty-four loaded coal cars and a steam locomotive. It was too much of a pull for the motor. The coal train was to have gone north. The motor was in charge of William Cooper, who has been testing it since its arrival here. In addition, there were aboard the motor Dr. Louis Duncan, the Baltimore and Ohio Railroad's consulting electrical engineer; S. H. Browne, his assistant; L. H. Parker, the representative of the General Electric Company, of New York, and Mr. Potter, an electrical engineer from Schenectady, who designed the controller of the motor. The start was a slow one, and it was evident that the test was about all the motor could stand. When the middle of the tunnel was reached the shoe of the trolley was found to be red-hot, and the connection from the shoe to the car broke. There was no time for repairs, for northbound trains were expected. So the locomotive to which the cars were attached made an effort to pull the motor, train and all, but it could not budge them. The cars were then divided into two sections, and the motor and nine cars were first taken through, and then the fifteen cars were pulled through by the locomotive. The electrical engineers say that the trouble experienced to-day can be remedied, and that the test will be repeated in a few days.

A special dispatch from Baltimore of July 11 says:—A new explanation is now given of the failure of the large electric locomotive on the Baltimore and Ohio road to move thirty loaded coal-cars and a steam locomotive through the tunnel in Monday's test. Engineers Parker and Cooper of the General Electric Company say that the conduit through which the brass shoe, which takes the place of a trolley wheel, runs, had been up several months, and a great deal of dirt and rust had accumulated in it, which was not all got out by the few trial trips made. With a heavy load, this dirt and rust in one place offered so much resistance to the current as to create enough heat to expand the shoe and wedge it in the trough. This is considered sufficient cause for the failure of the test, and a gang of men has been set to work with scrapers cleaning the conduit and preparing for another test.

On July 12, a further test of the road was made, and proved quite successful, the cleaning out of the trolley duct overhead removing from the circuit the resistance that had prevented the proper flow of current.

THE TROLLEY FREIGHT ROAD FOR NEW HAVEN, CONN.

The trolley freight road (Manufacturers' Street Railway Co.) has now been approved by the councilmen as well as the aldermen, and the Mayor is expected soon to sign the ordinance. If the manufacturing development in Fair Haven is as great as is expected, 250 trains a day will become necessary, within the next five years, to handle the freight.

TROLLEY WIRES FOR BICYCLES.

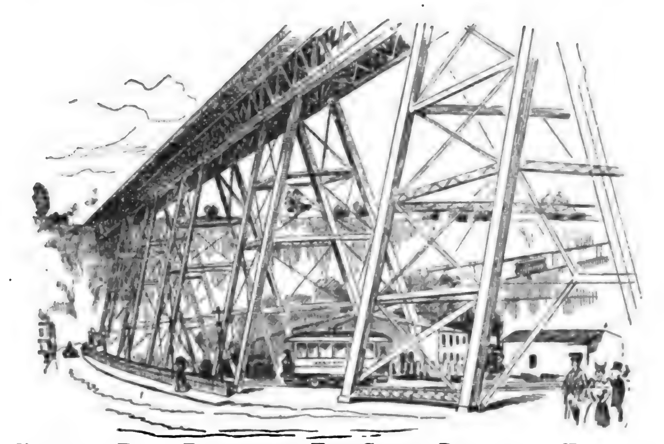
Being interviewed recently on the subject of bicycles, Mr. Edison said: "I believe that it is a matter of only a few years at most before hundreds of miles of special bicycle roads will be built with single line trolley wires overhead; especially in the mountains. Riders will have motors on their wheels which can receive current from the wires by trolleys so that quick spins may be taken. This would open up a new field of pleasure and usefulness to the devotees of the wheel.

"The system of driving tricycles by storage batteries and electric motors will undoubtedly be in use in a short time. Storage batteries have not yet been devised that would be light enough and small enough to be carried on bicycles, but I believe that batteries powerful enough to send a tricycle 20 or 25 miles and return, on good roads, could be made to weigh not over 60 pounds. A motor weighing 20 pounds would probably be sufficiently large to attain with this size battery a fair speed on a level road. A few years will probably see the system applied to trucking goods in city streets."

THE TROLLEY AT WEEHAWKEN HEIGHTS, N. J.—DISPLACING AN ELEVATOR AND STEAM ROAD.

One of the prettiest of the nearby resorts of New York City is Eldorado, a pleasure garden lying along the first spurs of the Palisades of New Jersey, and directly opposite West Forty-second street, the trip across the Hudson River being made in the West Shore Railroad ferry boats. The view up the Hudson valley and down the Bay to the ocean is enchanting, but there has been a serious drawback in the difficulty of reaching the lovely spot. For a long time, the ascent could only be made by an endless flight of wooden stairs or by ramshackle coaches plying over a very rough road. The increase in the popularity of the resort, together with the growth of the suburban population in that vicinity led finally to the erection of a huge elevator, at a cost of over $500,000, connected to the cliff by means of a trestle out upon which ran steam cars to receive and deliver passengers. The elevator cars, of which there were three, were of enormous size, each being able to lift about 200 people at a time. Even this arrangement has often proved inadequate to dispose of the crowds arriving from the ferry or returning to New York, after the performance at Eldorado or the races at Guttenberg.

When the elevators were put up, the trolley system was still young and was not considered adequate to such grades as were presented by the steep winding road; while an inclined plane was out of the question. But times have changed, and the trolley car has now been triumphantly introduced, so that the horse stages are abandoned, the elevators stand idle waiting to be torn down, and the trestle no longer will quiver under the oscillation of the steam cars. The trolley cars that have been put in service take the passengers quickly up the bluff and then in three different



Trolley Road Displacing The Steam Road and Elevator at Weehawken, N. J.

directions out into the suburban region on the westerly slope of the Palisades.

The roadway from the ferry has practically been remade and solidified, and a heavy iron railing has been put between the tracks and the edge of the road as a preventive of accidents. The cars have each two four-wheeled trucks and are equipped with powerful hand brakes.

As a matter of fact, the whole steam system of the North Hudson County road connecting with the ferry is being converted to electricity. At present six of the old steam cars have been made over into trolley cars, as described, with Brill trucks, and General Electric motors; and these run up as far as Hudson Heights, over the old steam tracks, making as much as thirty miles an hour. The remaining dozen cars are now, it is said, to be converted and the whole line up to Fort Lee will be operated electrically by the Fall of the year. The steam tracks have simply been bonded and poles set each side to carry the span wires. Current is fed into the system from the two power houses of the road furnishing the other connecting trolley lines.

Milwaukee, Wis.—The proposition to enforce 4 cent car fares by city ordinance, has practically fallen through, the aldermen putting it on file without vote.

Windsor Beach, near Rochester, has an electric fountain, on the lines of those at the World's Fair. It is lit by a special 20 H. P. dynamo and the water is pumped by a 30 H. P. motor. It runs nightly every 15 minutes between the hours of 9 and 11, and is described as very pretty.

THE PROBLEMS OF ELECTRIC RAILWAY WORK.[1]

BY OSCAR T. CROSBY.

LONG-DISTANCE electric railroading is a mere question of the magnitude of the amount of capital invested. The work to be done cuts almost no figure; that is, electric locomotives can easily be made and have been made to handle the maximum freight or passenger service. The Baltimore and Ohio road is just about beginning the operation of three electric locomotives, carrying trains through the tunnel in Baltimore, in order to avoid smoke and gases. As long as three years ago I made a contract with the Baltimore and Ohio Company for this work with the Thomson-Houston Electric Company. The real question as between the proper use of steam and electricity on any given line is one of frequency of service, and this becomes important because upon it depends the economy with which a central station may be operated. It should be remembered that back of all electrical generators we must still supply some prime mover, and, practically, this prime mover must be either a steam engine or a water wheel. While water power will rapidly come into play it remains true that large sections of country must for many years depend upon the steam engine as the primary source of electrical power.

In such cases the economy to be obtained, if any, by electric locomotives over steam locomotives will depend upon two things. First, the difference in coal consumption for a unit of power in a large stationary engine plant, as against the lower consumption of a locomotive which works under comparatively trying conditions in regard to this point. Second, the greater economy in the matter of repairs in an electric locomotive over a steam locomotive, and this extends to a lower maintenance account to the track, which is less injured by an electric locomotive of a given weight than by a steam locomotive. Out of these two economics we must get enough to pay an increased interest charge (because the electric roads cost more than the steam railroads) and we must also cover the amount of power wasted in transmission from the central station to the locomotives.

The result of these conditions would be in favor of the steam locomotive unless the central station can be operated under advantageous conditions.

It is plain that no central power station is working advantageously if the maximum power for which it is established should be called for only a short while each day.

Let us assume a somewhat extreme case, namely: That a certain section of road which is being supplied by a central station is fifty miles long, and two trains, each requiring approximately 1,000 horse power at the station, should come together on this section and occupy it for say two hours, and that during the remainder of the twenty-four hours the station would not be doing any work. It will appear to every one that in such a case such a central station would develop its power at a very high cost per unit. If, on the other hand, such a station could be developing approximately its full power for twenty-four hours, the cost of power per unit would be very much lower. An example of this latter case is seen in the ordinary central station for street railway service.

The value of all the elements entering into the problem have been carefully calculated by me and the results published in papers presented to scientific societies and in Crosby and Bell on the Theory and Practice of Electric Railroads.

Without going into the detail of such calculations, which are extremely uninteresting to those not required to follow the subject, it may at once be said that there is no steam railroad service in the Southern or Western States that could profitably be changed to-day into electric service. On the other hand it may also be safely said that the service of the Pennsylvania road between New York and Philadelphia, and the service of the Consolidated road between New York and New Haven, and the service of the New York Central road as far north as Yonkers could be performed at slightly less cost by electricity than by steam. Likewise, there is no question as to the desirability of electricity over steam on any elevated railroad in a large city where the trains are necessarily run at frequent intervals. In this particular case, also of city service, there are other advantages quite aside from those of economy. There are the superior cleanliness and less noise.

For all classes of service electric locomotives offer an advantage over steam which the world will more and more learn to appreciate; that is, very high speed. The maximum recorded speed of a steam locomotive with train is 112 miles per hour, made over only a few miles on the New York Central road, near Rochester. The maximum recorded speed of an electric locomotive is 120 miles per hour, made experimentally under my direction a few years ago. But these figures do not in themselves give proper comparison of what can be done by the two methods. Aside from the mechanical difficulties of reciprocating action, which alone would seriously hold down the speed of the locomotive, the controlling influence which would limit the speeds of locomotives very nearly to those which have been attained already, lies in this, that the boiler is unable to furnish sufficient steam at a high pressure for any considerable run. An electric locomotive on the other hand, since it receives its power in an intangible and imponderable form may maintain indefinitely any speed it may attain for even a minute under any given conditions.

The dead weight to be carried by an electric locomotive is less than in the case of steam, and it may also be arranged to produce less atmospheric resistance for a given load behind the draw bar. This matter of atmospheric resistance becomes of considerable importance only when the considerations of abnormally high speeds are in question.

Substantially as we move on in the matter of speed, say beyond 100 miles an hour, we are driven almost exclusively to the use of the electric locomotive. At the time the high speed experiments above mentioned were made by me there was considerable skepticism even among electrical engineers as to the feasibility of any great advance in the matter of speed. Meanwhile, however, so much has been accomplished practically and theoretically that all well-informed experts are agreed that nothing save the inertia of capital now lies between civilization and a transport speed of 150 miles an hour. It is probable that the earliest line on which such high speeds will be regularly adopted will be that between New York and Philadelphia.

Speaking of speed, but coming to a lower plane, I can say that the people of New Orleans can be congratulated on having what is probably the highest speed of trolley cars in the country. This is due to the flatness of the city and the existence of so much of what is here known as neutral ground. There are not many blessings connected with the peculiar topography of this city, and this particular advantage should therefore be the more cherished.

Among the things not permitted by your topography may be mentioned the underground electric railroad; that is, the electric railroad in which the conductors or trolley wires are placed in a conduit similar to the conduits carrying the wire rope in the cable car system. A few years ago I saw a very satisfactory example of such an underground railway in Buda-Pesth, in Hungary. A short line, similar in general construction, has for some time been operated in Washington, and a more considerable plant is now being built in the same city, while in New York the Metropolitan Traction Company are just beginning the operation of three or four miles of track equipped in the same way. The same causes which leave the streets undrained and unsavory at times would render the application of this method quite impracticable in this city. The matter, however, is chiefly one of æsthetic value, since the ordinary operation of the cars is in nowise improved; the expense of insulation is much greater, even in favorable topography, and the only advantage gained lies in getting the wire and poles out of the streets. As to the present status of electric lighting, that which has been done during the past few years is rather the improvement of detail than change in any radical element of the problem. Some comparatively new forms of machinery, known generally as those of the multiphase type, have been adopted under the pressure felt for increasing the distances over which electric power may be commercially transmitted. As a mere matter of engineering possibility it should be borne in mind that electric power may be transmitted 1,000 miles with any small percentage of loss desired, but such a thing would not be commercially possible because of the immense cost of the conducting and insulating devices required for such distances. The effect is to increase the electrical pressure or tension at which the power is transmitted, since such increase of pressure carries with it a decrease in the amount of copper required. To-day there may be found in the ordinary street railway service where it extends to suburban lines instances where power is transmitted ten miles. There is an interesting instance of power transmitted from the falls of Tivoli to the city of Rome, a distance of eighteen miles. There are examples in this country, chiefly in the mining districts, of distances equal to this last named. Much longer distances of transmission may even now be justified in cases in which the cost of developing the water power is not large and the cost of coal not small; thus on the Pacific coast at Los Angeles coal is $11 per ton. In some of the neighboring mountains water power may be had, although at a distance approximating 100 miles. In such a case, even with present methods, it might be commercially desirable to make such a transmission. The climatic conditions on the Pacific slope are generally favorable in the matter of insulation; on the other hand, between Buffalo and Niagara Falls the climatic conditions are severe. It is in this locality that we assume to see much and learn much in the art of power transmission. The Cataract Construction Company are just beginning to use their first 5,000-horse power dynamo. The distance to the centre of the city of Buffalo is about twenty-two miles. Coal in Buffalo is very cheap, less than $2 per ton, yet there is no doubt that the Cataract Company will be able to sell power profitably at considerably less than the cost of power produced by coal. Between these two cities there is also just completed an electrical railroad on which the normal speed will be thirty-five miles per hour, and when I made the contract for building this road it was expected that we would be able to start with power from Niagara Falls. We may be dis-

1. *New Orleans Times Democrat.* Abstract of Interview.

appointed for a few weeks in this matter, but it will be only a question of two or three months when this fine example of force will be in daily use.

THE BRILL TROLLEY SPRINKLER.

We illustrate herewith two interesting forms of trolley street car sprinkler put upon the market by the J. G. Brill Co. of Philadelphia. Sprinkler building is no longer a casual branch of the art, but is conducted with care and a close study of details. The form, Fig. 1, as will be noted, has a roof over the tank for supporting the trolley. The length over the sills is 16 feet, the width over

FIG. 1.—THE BRILL TROLLEY SPRINKLER AT BALTIMORE.

the side sills 6 feet 10 inches. The approximate weight is 9,930 pounds. The cedar tank has a capacity of 2,390 gallons. The regular type of sprinkler has a 3-inch outlet, studded with 3-16 in. holes, but the latest pattern includes an improvement whereby the water is led to the orifice of the pipe which is practically plugged with a conical shaped spur. This has the effect of throwing the water in a film over the edge of the cone, and distributing it advantageously. There are also auxiliary sprinklers for soaking the rails thoroughly to ensure good contact. The tank is mounted on the Brill No. 7 independent non pivotal truck having solid

FIG. 2.—BRILL ELECTRIC SPRINKLER CAR FOR JERSEY CITY.

forged axle box frame. There is a radiating draw-bar at each end, and a brake handle. Many of these sprinklers are being placed by the Brill Co., the one shown being of the type in use on the Baltimore City and Suburban. Another special type of the same general design has been built recently for the Consolidated Traction Co. of Jersey City. The capacity is also the same, but the tank is of steel, without a roof. The spray thrown has a 12-foot range.

PENNANT FOR STREET CARS WITH UNITED STATES MAILS.

The Post Office Department has agreed upon a miniature pennant, modeled from the pennant used on steamships carrying the United States mails, for street cars carrying the mails. The pennant will be two feet long, red with a blue border, with the eagle and an inscription, "United States Mail," in white letters. The pennant will only fly when the mail is on the car.

MISCELLANEOUS.

THE WATER POWER CONTRACT AT KEOKUK, IA.

The contract between the city of Keokuk and the Des Moines Rapids Power company, whereby the city agrees to take 500 electrical horse power at $30 a horse power a year for a period of five years, has been signed by both parties. While the price is stated to be $30, it is provided that should the company furnish any other party, in the city or without, with power at a less rate, the price to Keokuk shall be reduced accordingly. The power company is bound to furnish power to all who demand it and at a reasonable and uniform price, not exceeding $30 for quantities exceeding 500 horse power and a sliding scale of prices for less amounts. To secure the faithful performance of the contract the city retains 12½ per cent. of the contract price until the end of each year. The city has the power to increase the amount of power it takes up to $1,000 at the same figure, and may renew this contract at pleasure. The power company agrees to begin work within six months from July 2, 1895, and have the plant in operation within a year.

UTILIZING THE WASTE WATER OF THE POTOMAC FOR ELECTRIC LIGHT AND POWER.

An extensive scheme is on foot for the utilization of the waste waters of the Potomac at Hagerstown, Md., for electric power. The matter is being pushed by a syndicate represented by Mr. Powell Evans of Philadelphia. At either of two dams in the Potomac River, conveniently situated in regard to Hagerstown, there is a foot and a half of water going over. This represents 4,800 cub. ft. a second, or 7,500 H. P. Sixty per cent. of this power can be transmitted to the town by electricity. The fall of the water at Dam No. 5 is eighteen feet. Here are located the Potomac Pulp Mills and water wheels are already up. These may be used by the company. At Dam No. 4 the fall of water is twenty-three feet. The new company is said to contemplate a street railway for Hagerstown, with extensions to Williamsport and Funkstown, the building of power houses, and the purchase of the electric light plant, in all to cost $300,000.

The stated plans of the syndicate are as follows: They propose to contract with the Chesapeake and Ohio Canal Company at Dams No. 4 and 5 and utilize the great water power at those points. A complete system of electrical street railway is to permeate the principal streets of Hagerstown. A continuation of the system is to extend to Williamsport, following the Williamsport pike, and a park is proposed to be built.

The electric light plant in Hagerstown it is proposed to purchase and operate in connection with the railway system. They also propose supplying power to the manufactories of Hagerstown at a rate greatly in reduction to that paid by the factories at present.

ELECTRIC POWER WANTED AT SLATINGTON, PA.

The Washington Slate Co., of Slatington, has been organized with a capital of $100,000. A. P. Berlin is president and manager. The company has opened a new quarry, and proposes to utilize electricity in its operations on an extensive scale. The plant will include mining machinery, hoists, pumps, and drills, and will presently be extended to the working of surrounding quarries. The central electric plant will be a 25 to 30 K. W. dynamo, 250 volts; a 25 H. P. motor for hoist; a 7½ H. P. motor for pump, and a 5 H. P. motor for drill. The conditions for the successful operation of electric power are so favorable that the company is desirous of communicating with reliable parties from whom to obtain estimates for this class of work. It is also desirous to interest capital for the erection of a large plant for the furnishing of electric power to conduct quarry operations in the district, as well as for street railway purposes and electric lighting. The company proposes to organize a special corporation for this purpose, and to take an active part in developing the exceptional possibilities which are presented.

COMMENDATION OF "THE ELECTRICAL ENGINEER" DATA SHEETS.

We are receiving many commendations of the ENGINEER Data Sheets, of which the publication has just been begun. Mr. W. A. Mosscrop ,M. E. of Ansonia, Conn., ordering a filing case for them writes: "These are a good thing; push 'em along." Mr. R. E. Clark of Berlin, Wis., writes: "Send me one of your filing cases, morocco, for Data Sheets. I think those Data Sheets are what has been long looked for by electricians. They are fine." Mr. F. C. Turner of Chicago "is quite taken with the Data Sheets and thinks they are a very fine addition to the paper." Mr. H. V. Parsell, Jr., writes: "I must congratulate you on the inauguration of the Data Sheet system. It is what I have been longing for and dreaming about. I hope they will appear quite rapidly just now, so as to fill up the long-felt want. Please send me a morocco filing case."

TELEPHONY.

MARSHALL DUPLEX TELEPHONE SYSTEM.

THE rapid increase in the use of the long distance telephone must soon bring forward the question of increasing the carrying capacity of the lines. In the telegraph the number of phantom lines, created by the inauguration of the duplex and quadruplex nearly equals in length those actually strung, and the time cannot be far distant when similar methods will have to be applied to telephony to keep down the cost of operation and maintenance.

Among the various methods of telephonic duplexing suggested

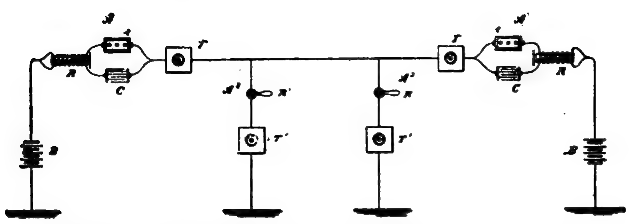
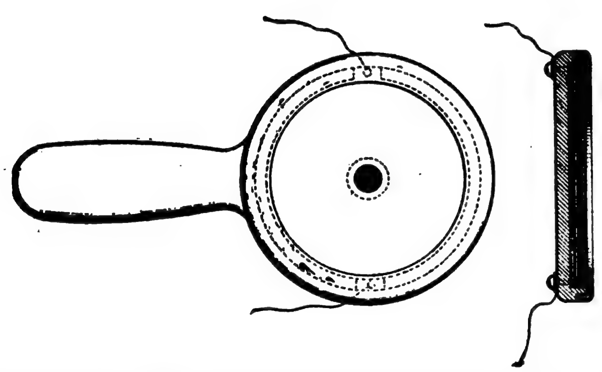


FIG. 1.—MARSHASL DUPLEX TELEPHONE SYSTEM.

is that due to Mr. William Marshall, the well known condenser manufacturer, of this city, whose system is illustrated in the accompanying diagram, Fig. 1. Here A A' are two terminal stations of a telephone line and A^2, A^3 are two intermediate stations on the same line. At the terminal station A, is a battery B one pole of which is grounded. The other pole is connected to line through a receiver R, and a transmitter T. The line is branched before reaching the receiver, and one branch is wound



FIGS. 2 AND 3.—MARSHALL CONDENSER TELEPHONE RECEIVER.

around the core of the receiver in one direction, and the other branch is oppositely wound around the same core. Beyond the receiver one branch passes through a resistance coil or box *r* while the other is connected with the terminals of a condenser C. The two branches unite beyond the condenser on the one side, and the resistance box on the other. The transmitter T is an ordinary carbon transmitter, but the line is connected directly to its terminals, the usual induction coil being dispensed with. In

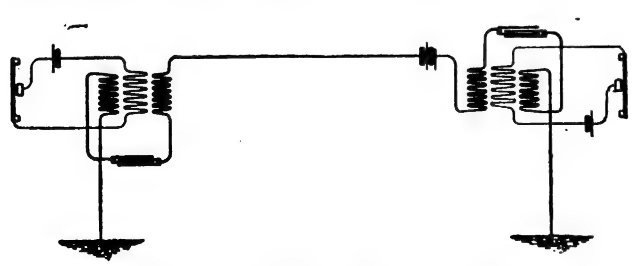


FIG. 4.—MARSHALL DUPLEX TELEPHONE SYSTEM.

this way the terminal station instruments operate by means of a direct or primary current.

The instruments at the other terminal station, A', are identical with those just described, and it is evident that operators at these two stations can communicate with each other in the ordinary way by means of their transmitters and receivers. In other words, the operation of the transmitter T, say at the station A, will affect the coil of the receiver R at the station R', or that part of the coil which is connected through the resistance box *r*. The other part of the coil which is connected through the condenser C. will be practically cut out and will remain unaffected by the direct current on line. At the intermediate station A^2, there is employed a transmitter T', connected to earth, and a receiver R.'

The receiver is a condenser receiver with alternate layers of tin foil and some thin insulating material as shown in Figs. 2 and 3. Every other sheet of tin foil is connected to the same pole or terminal of the receiver, while the remaining sheets of tin foil are connected to the opposite pole. This instrument makes an excellent receiver. It also serves in place of a condenser which by its alternate changes of static condition when the transmitter T' is operated, will affect the receiver at A^3 without disturbing or communicating with either of the terminal stations.

The connections at the terminal stations are illustrated in Fig. 4. It will be seen that the transmitter has two secondaries one of which is joined to line and to one pole of the condenser receiver and the other of which is joined to ground and the other pole of the receiver. The principle upon which this system operates is, that the direct current flows at the terminal stations through the branch containing the resistance and thus operates the receiver while the induced current flows equally through both branches without affecting the receiver.

SECRECY OF TELEPHONE MESSAGES IN NEW YORK.

An amendment to the penal code that will go into effect September 1, requires employés of telephone companies to maintain secrecy regarding the nature of the business carried on over the lines, the same as those who handle telegraphic messages are required to do.

A TELEPHONE STRUGGLE AT NEVADA, MO.

An injunction has been got out by the Missouri and Kansas Telephone Company, restraining the English & Haley Telephone Company from trespassing upon their lines by crossed wires. The wires of the latter company were cut in several places. The Missouri and Kansas Company has been operating its system for 10 years. The English & Haley Company was recently granted a franchise by the City Council and had secured a large list of subscribers at about half the rates charged by the old company. This action will result in keeping the new company out until the November term of the Circuit Court.

THE POSTAL TELEGRAPH SYSTEM NOT SOLD.

Mr. A. B. Chandler, President of the Postal Telegraph and Cable Company sent the following to the newspapers last week: "The recent publication of specific statements to the effect that the property of the Postal Telegraph and Cable Company has been sold to the Standard Telephone Company makes it necessary to say that no such sale has been made or contemplated, and no motive for the making of such a story is known either to the stockholders or the management of the Postal Company." What Mr. Chandler says at any time, on any subject—goes.

RAILROAD TRACK TELEPHONY.

A dispatch from Aberdeen, S. D. says:—A novel scheme is being considered whereby this city and Tacoma Park may be connected by telephone. It is proposed, providing the railroad company will consent, to connect a wire with a rail of the Great Northern Road at Tacoma, a similar connection to be made at this end of the line.

MUNICIPAL CONTROL OF TELEPHONES WANTED IN DULUTH

Some of the people of central Duluth, under the leadership of the Commercial Club, met last week and declared in favor of municipal control of the telephone franchise. The meeting was called because of a proposition now before the council to extend the time of the present company's franchise for a long term of years, which proposition includes the payment by the company of a considerable sum of money for the privilege of putting its wires in underground conduits.

MILDE TELEPHONES FOR CANADA.

The Montreal, Que. *Star* says:—Mr. T. A. Ness, of the firm of Ness, McLaren & Bate, Montreal, who has just returned from a trip to the Western States, while there closed a contract with the Standard Telephone and Electric Co., of Madison, Wis., for fifty thousand Mildé long distance telephone transmitters.

CENTRAL UNION THREATENS SUIT FOR INFRINGEMENT.

There is a telephone war at Mt. Vernon, O., and the Central Union Co. has served on all users of the opposition service a notice that all battery transmitters are considered infringements on the Berliner patents, and that infringers will be prosecuted.

TELEPHONIC "SPARKING" TOLLS AT EAU CLAIRE, WIS.

The superintendent of the Wisconsin Telephone company says the line is a sufferer by reason of the sparking and flirting carried on by the men and women of Eau Claire and Chippewa Falls. The company has adopted a rule that after a certain number of calls on the line between the two places a toll of 10 cents will be charged. This may have a tendency to reduce the conversation between the young people, and it surely will cut off many non-subscribers.

TELEPHONE NOTES.

SOUTH SALEM, CONN. is to have a telephone service.

MENASHA, WIS.—The Wisconsin Telephone company has been granted a franchise by Menasha.

ABERDEEN, MISS.—Under the supervision of Mr. Hugh Campbell a telephone service is being established.

MONTROSE, PA.—Work towards the putting in of the poles for the new local telephone company is progressing satisfactorily.

ASHEVILLE, N. C.—A company has been formed to erect a telephone line between Asheville and Rutherfordton.

WORCESTER, MASS.—The contracts for the erection of the new Bell telephone building have been let. The building will probably cost $60,000.

LE MARS, IA.—W. A Cottrell, of LeMars, has about completed the organization of a telephone company to build a line from Akron to Elk Point, S. D., and Sioux City.

RUMFORD FALLS, ME.—The Rumford Falls and Rangeley Lakes Railroad Company have bought the poles for a telegraph or telephone line to Bemis.

MADISON, WIS.—The Douglas County Telephone Company has been formed; capital, $80,000; incorporators, P. G. Stratton and Russell Baxter.

PITTSBURG, PA.—The new telephone company, of which J. N. Pew is president, is having plans prepared for the construction of the underground lines in the down town portion of the city.

CHAMPAIGN, ILL.—The Champaign and Urbana Phœnix Telephone Company has been formed; capital stock, $40,000; incorporators, P. S. Replogle, E. Frank Replogle and Jacob Frankel.

ELWOOD, IND.—J. M. Overshimer has purchased the Pana telephone exchange; consideration, $3,000. The exchange has two hundred patrons.

BETHANY, O.—The Bethany & Hughes Telephone Co. has been organized and is already operating a line from Bethany to Hughes Station.

NORTH CREEK, N. Y.—Leroy M. Carver, of Little Falls, has been awarded the contract for constructing a telephone line from North Creek, Saratoga county, to Newcomb, Essex county.

PENOBSCOT, ME.—The New England Telephone Co. extended their line from South Penobscot to South Brooksville and from Tapley's Corner to West Brooksville.

ANOKA, MINN.—There is a scheme on foot to start a local telephone exchange here. The projectors claim they have nearly enough signatures to warrant the building of the line.

CUTCHOGUE, L. I.—At a meeting of the stockholders of the Montauk, Orient and New York Telegraph and Telephone Company it was decided by a vote of 587 to 295 to sell out to the New York and New Jersey Telephone Company.

PIERRE, S. D.—Since the establishment of a telephone connection with Fort Pierre stock men of the range will build a line to Midland, a central point in the cow country, for the purpose of securing storm warnings from the weather bureau in that city.

MINNEAPOLIS, MINN.—There is a well-founded rumor afloat that the Northwestern Telephone Exchange will shortly put in a subcentral station in Minneapolis, to relieve the present overcrowding of the subway system.

PILOT MOUND, IA.—The Lower Vein Coal and Railway Company are putting up a line of telephone poles between Pilot Mound and Fraser, and will soon have a telephone service established between the two towns.

STAMFORD, N. Y.—The Mountain Telephone Company have decided to increase their capital stock to $2,100, with which to extend their lines from Prattsville to Ashland, and east to Catskill, via Cairo.

ALBURGH, VT.—A new telephone line has been completed connecting Isle La Motte and Alburgh. The line is owned and controlled by Hon. N. W. Fisk and E. S. Fleury, and connects the island, which has been hard to get at, with the telegraph office at Alburgh.

LITTLE ROCK, ARK.—The Little Rock Telephone Company has filed in the Secretary of State's office a certificate of an amendment to its articles of agreement and incorporation increasing the amount of capital stock to $100,000.

CHARLOTTESVILLE, VA.—The Interstate Telephone and Telegraph Company is just finishing up exchanges in Charlottesville, Va., where they have 100 subscribers, and Frederick, Md., where they have 200.

SALT LAKE CITY, UTAH.—At the regular meeting of the board of directors of the Rocky Mountain Bell Telephone Company, it was decided to double circuit the system between Ogden and Logan as soon as circumstances will permit.

JACKSON, MICH.—R. B. Watson, telephone manager here, has been called to Detroit to become purchasing agent for the Michigan Telephone Construction Company. The vacancy will be filled by C. E. Mower of the Three Rivers exchange.

LIBERTY, N. Y.—The Sullivan Co. Telephone Co. will extend its system from Liberty to Liberty Falls, Strongtown and on to Monticello, which when completed will make an excellent telephone system.

ST. JOSEPH, MO.—The Missouri and Kansas Telephone Company will begin work laying their underground wires in the central part of the city, and building their new exchange, as provided for in the franchise granted them some time ago.

COUNCIL BLUFFS, IA.—The Iowa Harrison Telephone and Construction company has been formed in this city with S. B. Wadsworth, S. L. Etnyre, C. E. H. Campbell, A. W. Johnson and C. M. Hard as incorporators. It has $100,000 capital stock, with a privilege of doubling that amount if desired.

SUPERIOR, WIS.—The Douglas County Telephone company has filed articles of incorporation. The capital stock is $80,000. The incorporators are Pear Benson, P. G. Stratton and Russell Baxter. They will buy, purchase, lease or otherwise acquire and maintain and operate telephone and telegraph lines.

CHILLICOTHE, O.—The Home Telephone Co. and the Clarksburg and Chillicothe Telephone Co. will in future be operated jointly. This means that the Home Co. can now give its subscribers connection with Frankfort, Roxabel, Andersonville and all the western part of the county.

BOONE, IA.—The Boone County Telephone Company, with place of business stipulated as the city of Boone, has filed articles of incorporation. The amount of capital authorized is $10,000. The incorporators are A. A. During, Chas. E. Wells, R. G. Schaaf, J. L. Stevens, W. H. Crooks.

SIOUX CITY, IA.—The Home Telephone Company of Sioux City has been incorporated. The place of business is given as Sioux City, and the capital as $70,000. The incorporators are T. H. Johnson, A. H. Hazen, A. F. Call, F. W. Lohr, E. E. Hazen, George H. Hollister, F. L. Eaton and Richard M. Dott.

BRIDGEPORT, CONN.—S. A. Boyd, representing a body of capitalists has made the following statement: We intend to put in a perfect system at an expenditure of $250,000 to $300,000, and offer the best of telephone service at $4 a month in offices and $3 a month in houses.

SALISBURY, MD.—The county commissioners have granted a franchise to Mr. W. H. Jackson to erect a telephone from Salisbury to his farm, on the Quantico road. A franchise was also granted Messrs. Sampson, Truit, Major Humphreys and Mr. S. E. Gordy to erect a line to connect their farm with the town line.

OSKALOOSA, IA.—The Iowa Telephone company has issued an order giving its 180 city subscribers free rental until further notice. The order was issued just as the new local company was ready to open its exchange with a list of 400 subscribers, most of whom have been paying exorbitant prices to the old company.

WINONA, MINN.—A contract has been let to Electrician Bell, of Winona, to construct a telephone system between this city and Galesville, Wis. The line will pass through Marshland and Centerville, and have connections at this end with one of the city telephone exchanges.

LAURENS, S C.—A charter has been issued to the Laurens Telephone Company. The officers of the company are: Directors, J. F. Traynham, B. F. Posey, J. H. Sullivan, E. H. Wilkins, W. R. Richie and O. B. Simmons; president, J. H. Traynham, vice-president, B. F. Posey, and secretary and treasurer, W. R. Richie.

COLUMBUS, IND.—The Citizens Telephone Company, (anti Bell) has entered into a contract with the Rural telephone company by which the two systems will be connected. This will give Columbus telephone connections with a number of the smaller surrounding towns including Hope, Hartsville, St. Louis Crossing, Clifford, Flatrock, Nortonsburg, Petersville, Newburn and Burnsville.

CONWAY, ARK.—The Southwestern Telephone Company is putting in a telephone system for the town.

BALTIMORE, MD.—The contracts which have been secured by the Home Telephone Company have been counted. The total number was 3,448.

ELIZABETH, N. J.—The Elizabeth Mutual Telephone Company has begun the construction of its telephone lines through the city.

CARBONDALE, PA.—An ordinance has been passed granting to the Carbondale Telephone Company right to establish and maintain a telephone system within the limits of the city of Carbondale.

MOBERLY, MO.—D. P. Moore has received the incorporation papers for the Moberly Telephone Company, of which he is one of the leading members.

KANSAS CITY, MO.—The Grand Avenue Electrical works is the name of a new telephone Company that is being organized to put in an exchange at Kansas City. It is a branch of the Standard Telephone company of Madison, Wis.

WASHINGTON, D.C.—Tired of paying what they regard as exorbitant rentals for telephones, the Commissioners will, upon the beginning of the next fiscal year, equip a telephone service belonging to the District.

COUNCIL BLUFFS, IA.—Articles incorporating the Wizard Telephone and General Electrical Manufacturing Company of Council Bluffs have been filed. The capital stock of the company is $100,000.

FRAMINGHAM, MASS.—The Framingham selectmen have granted a franchise to the Framingham Telephone Company, a new corporation, capitalized at $15,000, which proposes to furnish service in Framingham and Natick.

ISHPEMING, MICH.—The Marquette County Telephone company has begun work on the construction of its telephone system in Ishpeming. F. R. Marsh of Chicago will have charge of the construction work.

HINTON, W. VA.—The new telephone company consists of the following Directors: P. K. Litsinger, President; J. M. Ayers, Secretary; E. O. Prince, Treasurer; Directors, J. J. Swope, J. A. Oldfield, B. L. Hoge, P. K. Litsinger, H. Ewart, J. A. Parker, T. G. Swats.

BRITT, IA.—The Western Electric Telephone company of Britt, Hancock county has been formed. It proposes to operate a telephone line which shall extend through the counties of Cerro Gordo, Hancock, Kossuth, Palo Alto, Clay, O'Brien, Sioux, Lyon, Osceola, Dickinson, Emmet and Winnebago.

ELMIRA, N. Y.—The Susquehanna Telephone Company and the Metropolitan Telephone Company have been consolidated, and will be continued under the former title. Frank Zeller has been elected superintendent and Dr. W. W. Fletcher secretary. Dr. W. S. Mitchell has been elected treasurer.

CARTHAGE, MO.—The Carthage Electric Telephone Co. has filed articles of association, capital $5,000. Theo. J. Clark, Eliza C. Clark, Geo. E. Wheeler, Laura E. Wheeler and E. R. Wheeler, stockholders. T. J. Clark is president and treasurer, E. R. Wheeler, vice president, and Geo. Wheeler, superintendent and secretary.

RACINE, WIS.—A new telephone company has been established at Western Union Junction, which will operate a line between that place and Somers, Kenosha county, and will eventually extend to other towns in the two counties. The capital stock is $5,000 and the officers are: President, C. A. Brown; secretary, Frank Lingsweiler; treasurer, Dr. Stonebreaker.

HAMBURG, ARK.—Articles of incorporation of the Hamburg and Portland Telephone Company have been filed. The incorporators are: J. D. Pugh, Chas. M. Woodward, J. H. Pryor, T. R. Pugh and T. B. Savage. The capital stock of the corporation is $3,000, of which $1,810 is subscribed. The object of the company is the construction of a telephone line between Hamburg and Portland, in Ashley county, nearly twenty-five miles.

CLINTON, IA.—B. S. Price, general foreman of the Postal Telegraph Cable Company, has been selecting a route for a new telephone line between Dubuque and Muscatine. He says the company intends to establish a new line connecting river points from Dubuque south to St. Louis, with competing offices at Clinton, Davenport, Welton, Muscatine, Burlington, Fort Madison, Keokuk, Quincy, Hannibal and St. Louis.

OAKLAND, CAL.—A corporation known as the Commercial Telephone Company has filed articles with the County Recorder preparatory to doing business in Alameda County. The directors are E. R. Smith, Albert L. Stetson, J. D. Johnson, John W. Butler and S. P. Lunt. The capital stock is $100,000, divided into 1,000 shares of $100 each. It is estimated that the line will be a hundred miles long.

THE ELECTROTHERM: THE ELECTRIC HEATING PAD OF THE H. W. JOHNS COMPANY.

In putting on the market a new invention, the first consideration of the inventor is, naturally, how much grist it will bring to the mill, how many dollars there are in it. But when that point has once been agreeably assured, there is a good deal of extraneous satisfaction in the idea that every sale of the article invented is a piece of practical philanthropy that is certain to play a large part in reducing human suffering, and may even be instrumental in saving life itself. The H. W. Johns Company are to be congratulated on being in a position to undergo this experience, and the success which has attended the introduction of their new "Electrotherm," or electrical heating pad is as gratifying to the public as it is to themselves. The electrotherm is a flexible sheet or pad of asbestos. In the pad are embedded the heating wires, which receive current on connection with the socket of an electric lamp, or a battery. Practically, any degree of heat, say, from 130 to 220 deg. Fahr., can be produced, and maintained for any length of time, and where even a higher temperature is required, it can be attained by the use of additional covering. Such a device lends itself to innumerable uses; but in medical work it is simply invaluable. The hot bottle has always been a clumsy makeshift. It was the best the nurse could do, but it was lamentably inefficient, and often involved serious risks. At the critical point of a case, absolute freedom from disturbance often becomes as eminently essential to the patient as the maintenance of vital warmth and the necessary substitution of a fresh set of heating bottles was often attended with the greatest danger.

The slightest relaxation in watchfulness on the part of the nurse might cause serious burns, and there were always the factors of the varying sensitiveness of skin in different subjects, and the development of the latent heat of the bottles, to be guarded against. The Electrotherm overcomes all these difficulties. Heat of any degree, gentle or strong, can be imparted to the patient, and maintained without variation or disturbance for days, or weeks, if need be. If the effect of a poultice or moist heat is required the Electrotherm is applied over one or two thicknesses of wet flannel. Hospital doctors and nurses are most enthusiastic in its praise, and hardly less so are the many veterinary surgeons who have used it with great success in the treatment of numerous diseases of horses and cattle. The Electrotherm is made in several forms: as a pad 11 in. by 15, and ¼ in. thick, for general domestic or surgical use; as a foot warmer, in the shape of a pad covered with wickerwork; as a special collar, chest and back pad combined, covered with felt or rubber; rugs, blankets, mats for operating tables, sweating jackets, etc., and in fact, in any shape or size required. It is made for any voltage from 5 to 125 volts, and can be used with either direct or alternating current. The voltage required is printed on each article. The temperature is regulated by a switch newly patented by the H. W. Johns Company, the manipulation of which is perfectly simple and easy. The cost of maintaining a constant heat in the ordinary pad does not exceed one cent per hour, and a given number of pads will virtually give the service of nearly twice that number of hot water bottles.

THE "STANDARD" STORAGE BATTERY.

A NEW storage battery of which great things are expected, is about to be placed on the market, under the name of the "Standard." It is the invention of Mr. J. Hart Robertson, who was formerly identified with the writing telegraph, and Mr. J. Heron Crossman, of 50 Exchange Place, is largely interested in its patents. The "factory" plant is now open for inspection at 80 Pearl St., Brooklyn. The cells of this plant exhibit the ordinary characteristics of the Standard battery, but it is understood that a cell of extraordinary lightness, intended for traction and other work where the saving of weight is a desideratum, will be tested very shortly. The Standard factory cell is of the Planté type, 12 in. x 7½ x 4½. Its general appearance indicates solidity and serviceableness. Its 5 plates, the three inner of half-inch, and the two outer of one-quarter inch porous lead, and insulated by paraffined wood, are bolted together securely by hard rubber rods. The main feature of the cell is that by a simple and ingenious process any degree of porosity can be imparted to the lead at the moment of casting, and the claim of the inventor is that the battery will give as large an efficiency as any storage battery now on the market, with half the weight of cell, and at half the cost. In spite of the large amount of active surface secured in the plate, which is made from one piece of lead, it is very strong and serviceable. Buckling is absolutely provided against, and sulphating is reduced to the minimum. The internal resistance of the battery is exceptionally low, and the stated efficiency is very high. The figures of actual tests will shortly be available. An extended description of this invention must be reserved until after the public demonstration of its capabilities, which will be made during this week. For the present it may be said that it appears to possess many of the qualities which will lift the accumulator still higher in practicability for general work.

Society and Club Notes.

NORTH WESTERN ELECTRIC LIGHT ASSOCIATION.

The North Western Electric Light Association will hold their summer annual convention in Chicago, July 17, 18 and 19, headquarters at the Leland Hotel. Accommodations have been secured for exhibitors on the parlor floor, and arrangements for space can be made with Wm. Goltz, secretary of the Association, Milwaukee. Programme, July 17: Business meeting, 9 to 12; afternoon: Delegates will visit the plants of the Metropolitan Elevated R. R. and Chicago Edison Co. by special invitation. July 18: Business meeting, 9 to 12; afternoon: Special train to drainage Canal stopping at Sag and Lamont the two most interesting points on the work of the Canal up to date. For the evening the body of the house has been secured at the Columbia Theatre ("Merry World") and a topical song will be given containing references to the meeting and the delegates. July 19th.: Business meeting as before; delegates taken through the Boulevards, World's Fair grounds and back to the hotel. Mr. S. F. B. Morse is Chairman of the Entertainment Committee, a sufficient guarantee of good time being provided.

Married.

Mr. Charles B. Price, of the Pettingell Andrews Co., of Boston is at present receiving many congratulations from his numerous friends, on the occasion of his recent marriage to Miss M. A. Grosvenor of Peabody, Mass. Mr. and Mrs. Price will be at home to their friends at 245 Lafayette street, Salem, Mass., after the first of September. Mr. Price has been for many years connected with the Pettingell Andrews Co., has made for himself hosts of friends and is deservedly popular amongst the electrical trade, who all wish him every happiness.

Legal Notes.

COMPENSATION FOR USE OF ANOTHER CO.'S TRACKS.

The principles that have been laid down by Judge Valliant at St. Louis in his decision in the case of the Grand Avenue Railway Company against the Lindell Railway Company may serve as a guide hereafter in determining the compensation which one street car company should pay for the use of another's tracks. The cost of maintaining the portion of the road used by both companies must be divided equally between them, as also the taxes and the cost of sanding, sprinkling, salting and cleaning the track, the latter including freeing the road of obstructing snow. Half of 6 per cent. interest on the value of the portion used is also to be allowed the owner.

Reports of Companies.

NEW YORK EDISON CO. EARNINGS.

	1895.	1894.	Increase.
Gross, June........	$135,879.90	$123,193.30	$12,686.60
Net, June.........	69,869.51	58,888.54	10,980.97
Gross, 6 months..	947,445.06	825,338.43	122,106.63
Net, 6 months....	474,895.69	409,639.36	65,256.33

These figures include the earnings of the Manhattan and Harlem Companies.

SALE OF ELECTRIC ACCUMULATOR CO.'S STOCK.

The affairs of the Electrical Accumulator Company have been wound up in Philadelphia by a master's sale authorized by the United States Circuit Court in foreclosure proceedings instituted by the holders of the first mortgage of $500,000, and the principal assets of the company were 321,117 shares of the Electro-Dynamic Company's stock and 18,000 shares of stock of the Electric Storage Battery Company. Most of the assets were bid in by L. F. Potts, representing a syndicate interested in all three companies. The Electro-Dynamic stock, with a claim of $270,000 against the company, brought $125, and the bank accounts of the Accumulator Company $675. Nine hundred shares of the Electric Storage Battery stock brought $27.50 a share and the remainder $24 a share.

BIDS WANTED FOR A NEW HOSPITAL, WASHINGTON, D. C.

The Department of the Interior, Washington, D. C., is inviting proposals until 2 o'clock P. M. Monday, July 22nd, for furnishing and installing an electric light plant, at the Government Hospital for the Insane, near that city in accordance with the following official specifications. There are to be two plants, on the three-wire system, consisting each of a compound condensing engine, and a pair of compound wound self-regulating dynamos, with central station switch board of slate, ampere and volt meters, ampere shunts, knife switches, etc., complete for each plant. The aggregate output of the larger plant is to be 100 kilowatts, and of the smaller plant, 50 kilowatts, at 125 volts electro-motive force at the poles. The contractor to furnish superintendent in erecting and connecting all of the machinery, but the labor and freight will be furnished by the Institution.

The engines are to be compound, with two cylinders, opposite cranks, automatic cut-off governor, and to regulate within one and one-half per cent. between full load and no load, to run without thump or jar; to have heavy cast-iron foundation boxes, on brick or masonry foundation; to have approved sight feed oilers, proper drip pans, cast iron parallel lagging; to be fitted with counters and with indicators, connections and motions. The engines and driving wheels to be well balanced. The frames to be of cast iron, and heavy, the working part of wrought iron or steel, with factor of safety not less than five nor more than eight, with 100 pounds pressure on the H. P. piston. Working parts to be polished. The engines may be either horizontal or vertical, and they may be either directly connected or belted with four strand manilla ropes, if horizontal, the cylinder of the large engine to be about 13 and 20 1-2 inches in diameter, with a stroke of piston of 15 inches; to make 265 revolutions a minute; to have two rope wheels, each wheel having eleven (11) grooves for three-fourth inch diameter ropes. A templet for the grooves will be furnished to the contractor. The diameter of the rope wheels to be 74 inches on the pitch line. A 5-inch Stratton separator with a No. 2 Baird steam trap to be furnished for the steam pipe.

The smaller engine if horizontal is to have steam cylinders about 10¼ and 16¼ inches in diameter respectively, and 12 inches stroke of piston, and to make 285 revolutions a minute. To have two rope wheels 74 inches diameter on the pitch line, scored six (6) ropes each; ropes and grooves to be the same as on the larger engine. A three and one-half inch Stratton separator, with a No. 1 Baird trap to be provided for the steam pipes. The design, workmanship, and finish of the engines to be equal to that of the Armington and Sims engines.

There must be a satisfactory jet condenser and air-pump for each engine; the air-pump for the large engine to have ten inch steam cylinder 12 inch water cylinder, by a fourteen inch stroke; for the small engine the air pump will have 7 inch steam end, 9 inch water end, and 12 inch stroke of pistons; to have brass lined water end, brass water pistons, guards and springs and rubber valves. Air pumps and condensers, to be equal in all respects to the Davidson.

The dynamos are to be in pairs, direct current, and for the three wire system. They are to be compound wound, self-regulating, capable of exerting a constant pressure of 125 volts at the poles. Under these conditions the larger pair shall have a capacity of 1000 amperes, and the small pair 500 amperes. Approved regulators for the shunt circuit are to be supplied. The commercial efficiency of the dynamos is to equal eighty per cent. The winding of neither armature nor field to heat more than 60 degrees Fahr. above the temperature of the room, at full load. To be insulated electrically from their bed-plates; commutator bars to be of hard copper, insulated with mica, not less than one and one-half inches deep. Armature to have self-lubricating bearings, and with relatively large surface. Brushes to be of approved kind, easy of adjustment, and with abundant bearing surface.

The larger pair of dynamos is to equal in all respects two Edison No. 32, and to have rope wheels 30 inches, and the smaller ones to equal a pair of Edison No. 12, central station switch board and dynamos, with rope wheels seventeen and three-fourths inches diameter on pitch line, in lieu of belt pulleys.

Tests. The larger engine must be able to indicate 200 H. P. the smaller engine 100 H. P., with 100 pounds pressure in the boiler, and 25 inches of vacuum in the condenser. The insulation of the dynamos, conductors, and switch-boards not to be less than 500,000 ohms.

There will be provided and fitted one spare armature for each size of dynamo, and a spare set of crank pins, and cross-head brasses to be for each engine.

Alternate bids on vertical engines directly connected will be considered, provided the cranks are opposite, the steam cylinders as close together as practicable, and the engines and dynamos are equal in all other respects to the above specified plants.

All proposals must be in duplicate, addressed to the Secretary of the Interior, Washington, D. C., sealed, and endorsed on the envelope, "Proposal for Electric Light Plant."

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JULY 2, 1895.

Alarms and Signals:—

Block Signal for Railways, W. G. Roome, Jersey City, N. J., 541,949. Filed April 28, 1893.

Police Patrol Signal, E. Brombacher, Buffalo, N. Y., 542,074. Filed Nov. 26, 1894.

Provides the box with simple means whereby the fast and slow call button can be shifted from one position to the other under all circumstances without the necessity of opening the door of the box.

Signaling, D L. V. Browne, Denver, Col., 542,142. Filed Sept. 12, 1894.

Means for signaling from the moving buckets or cages of mining or similar shafts from elevator cars.

Conductors, Conduits and Insulators:—

Manufacture of Electrical Conductors, L. W. Downes, Providence, R. I., 541,931. Filed April 2, 1895.

An insulated electrical conductor comprising a wire, a fine fibrous covering coated with a film of rubber, a compact winding of asbestos fiber saturated with soluble glass, and an exterior braided asbestos covering coated with fire-proof cement.

Apparatus for Manufacture of Wire, R. D. Sanders, Eastbourne, Eng., 541,986 Filed Sept. 20, 1894.

Claim:—In an apparatus for the manufacture of wire by electro-deposition the combination with a non-metallic cylinder having a spiral or suitable groove cut or formed therein, of a wire strip inserted or laid at the bottom of the said groove, and the pins and conductor in electrical communication with such wire or strip.

Electric Wire Joint, A. Gartner, Newark, N. J., 541,998. Filed May 24, 1895.

A wire joint consisting of a tube, provided with a longitudinally and spirally arranged slot, said tube being adapted to be twisted with and around the inclosed wires.

Dynamos and Motors:—

Dynamo Electric Machine, T. H. Hicks, Detroit, Mich., 541,854. Filed Aug. 29, 1894.

Relates to a machine having a double armature circuit intended for three-wire system, but each armature being independent of the other.

Commutator Brush, H. B. Collins, Fulton, N. Y., 541,919. Filed Jan. 26, 1895.

Details of construction.

Electrometallurgy:—

Electrolytic Process and Apparatus, L. P. Hulin, Modane, France, 542,057. Filed Dec. 19, 1894.

Consists in effecting the electrolysis of a suitable haloid salt of an alkali or alkali earth metal when in a state of igneous fusion, by means of two anodes, one of carbon, and the other formed of the heavy metal to be alloyed.

Galvanic Batteries:—

Galvanic Battery, R. W. Gordon, Boston, Mass., 542,049. Filed Jan. 31, 1895.

The positive and negative elements and the depolarizing agent are arranged to obtain the greatest possible output of current with a minimum deterioration caused by the action of the battery.

Lamps and Appurtenances:—

Incandescent Electric Lamp, R. Greer, Westbrook, Me., 541,929. Filed Nov. 10, 1894.

Consists in placing wholly within a receiver upon suitable supports a glass bulb open at its lower end, and then inserting into the receiver a plug consisting of a filament and its support the base of which is encircled with elastic material, then closing the receiver and exhausting the air therefrom, and then forcing the plug into the glass bulb.

Safety Device for Handling Electric Arc Lamps, E. P. Snowden, St. Joseph, Mo., 542,210. Filed Mch. 23, 1895.

Railways and Appliances:

Rail Bond, P. Cunningham, New Bedford, Mass., 541,838. Filed Apl. 1, 1895.

Claim:—The combination with the rails of an electric railway, of a rail bond comprising eyeleted pins or rods inserted through holes in the rails and split or divided as described, and a tie wire inserted into the eyes of the eyeleted rods and secured therein.

Trolley Wire Clip, F. W. Haeusgen, Buffalo, N. Y., 541,969. Filed Oct. 9, 1894.

Trolley Restoring Attachment, W. D. McDaniel, Philadelphia, Pa., 542,002. Filed Oct. 29, 1894.

The restoring wheel has a spiral groove.

Electric Locomotive, T. E. Adams, Cleveland, Ohio, 542,086. Filed Oct. 3, 1894

Means for flexibly supporting the motor on the axles of the car independently of the truck-frame.

Conduit Electric Railway, L. C. Pressley, San Francisco, Cal., 542,105. Filed Feb. 18, 1895.

The car operates switches admitting current to insulated sections.

Conduit Electric Railway, L. R. & A. H. Lavalle, Holyoke, Mass., 542,164. Filed Mch. 17, 1894.

Employs a continuous insulated conductor connected in a series of blocks which are cut in and out by the passing car.

Switches, Cut-Outs, etc.:—

Automatic Safety Device for Electric Circuits, L G. Rowand, Camden, N. J., 542,030. Filed Feb. 6. 1895.

Consists of a switch in shunt with the main circuit, the resistances of the shunt circuit being greater than the resistance of the line circuit under normal conditions.

Telegraphs:—

Automatic Telegraphy, P. B. Delany, So. Orange, N. J., 541,967. Filed Apl. 3, 1895.

Forms one of the characters, either the dot or the dash, and preferably the dash, of a greater width transverse to the receiving ribbon than the other character.

Duplex and Diplex Telegraphy, M. M. Davis, Brooklyn, N. Y., 541,994. Filed Apl. 18, 1895.

Specially useful in a pole-changing transmitter where the succession of currents to line is abruptly changed from a maximum positive to a maximum negative.

Telephones:—

Telephone System, A. S. Hibbard, Chicago, Ill., 542,052. Filed Feb. 21, 1895.

Relates to a divided switchboard system.

Annunciator Circuit for Telephone Switchboards, C. E. Scribner, Chicago, Ill., 542,066. Filed Nov. 12, 1894.

The annunciator is wound differentially so as to avoid impedance when included in the talking circuit.

Magneto Electric Telephony, E. S. Halsey, So. Evanston, Ill., 542,191. Filed April 20, 1894.

The design is to maintain the magnetic flux practically constant and to effect the electric induction by variably diverting the current through two paths at some part of the magnetic circuit.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JULY 9, 1895.

Alarms and Signals:—

Railway Block Signal System, G. M. Brown, Galesburg, Ill., 542,550. Filed May 4, 1895.

Distribution:—

Transformer for Alternating Current Systems, E. Thomson, Swampscott, Mass., 542,295. Filed March 6, 1895.

A transformer for alternating currents, comprising two laminated cores, primary coils wound upon one of the cores, secondary coils upon the other, and links of copper connecting the cores and adjacent to the primary and secondary coils, the plates being connected to earth.

Electric Lighting System and Dynamo Therefor, M. Moskowitz, Newark, N. J., 542,487. Filed May 11, 1895

A railway car lighting system in which the dynamo has a differential series coil.

Galvanic Batteries:—

Electric Battery and Application Thereof to Medicinal Purposes, S. R. Beckwith, Orange, N. J., 542,459. Filed April 3, 1895.

Lamps and Appurtenances:—

Arc Light Support, B. Pickering, Dayton, Ohio, 542,279. Filed Nov. 15, 1890.

Details of construction.

Electric Arc Lamp, S. E. Nutting, Oak Park, Ill, 542,490. Filed Sept. 8, 1894.

The feed of the carbons is controlled by the action produced by the expansibleness of certain parts due to heat caused by the resistance to the current of electricity passing through that portion of the circuit.

Electric Arc Lamp, F. M., E. S. and H. F. Hildebrandt, Baltimore, Md, 542,589. Filed Dec. 27, 1893.

The arc is inclosed in a small transparent air tight casing provided in its upper end with a valve.

Measurement:—

Electric Meter, F. P. Cox, Lynn, Mass, 542,240. Filed Feb. 15, 1895.

Relates to recording wattmeters of the Thomson type adapted to constant current circuits.

Electrical Measuring Instrument, F. Holden, Schenectady, N. Y., 542,258. Filed Jan. 22, 1895

A field coil for an electric measuring instrument, composed of a serrated strip of conducting material having registering perforations through which the inner terminal of the coil is passed.

Electric Alarm Gauge, W. H. Brandt, Troy, N. Y., 542,406. Filed Feb. 23, 1894.

Details of construction.

Miscellaneous:—

Automatic Electric Weighing Scale, C. F. Wood, Richmond, Va., 11,508, Reissued. Filed June 20, 1893.

Weighs the requisite amount of seeds and deposits them in paper bags.

Electroprotective System for Locks, M. Martin, Malden, Mass., 542,368. Filed Oct. 4, 1894.

The testing part of the system is employed in conjunction with the lock whereby the person locking is required to make the test before the lock can be operated.

Electric Bath Apparatus, W. E. Golden, Auburndale, Ohio, 542,471. Filed Mch. 5, 1895.

Medical Electrode, A. P. Van Tuyl, Jr., Brooklyn, N. Y., 542,506. Filed May 15, 1895.

Electrically Controlled Motor, G. L. Thomas, Brooklyn, N. Y., 542,548. Filed Apl. 25, 1895.

The pressure of a fluid within an expansible chamber serves to set in motion an actuating rod.

Railways and Appliances:—

Trolley Breaker, H. P. Ball & C. A. Lieb, New York, 542,223. Filed Aug. 8, 1894.

Details of construction.

Underground Trolley, L. Binns, Philadelphia, Pa., 542,484. Filed Apl. 11, 1894.

Consists of a duct, a conducting-rail in the duct and connected with the source of electricity-supply, and a frame hinged on the under side of the vehicle and carrying a trolley-pulley.

Electric Railway System, R. B. Wilson, Cincinnati, Ohio, 542,512. Filed Jan. 2, 1894.

Details relating to a sectional system with insulated main conductors, and section magnets.

Trolley Finder, C. C. Lynde, Buffalo, N. Y., 542,591. Filed Nov. 28, 1894.

Telephones:—

Telephone Switchboard, J. F. Gilliland, Adrian, Mich., 542,249. Filed Oct. 26, 1894.

The switchboard is provided with a number of pairs of plates running parallel to each other and insulated from each other and unprovided with any circuit connections, the connections between two telephone lines being produced by pushing the plugs of the lines over the plates of the same pair.

Multiple Switchboard for Telephone Exchanges, M. G. Kellogg, Chicago, Ill., 542,262. Filed Dec. 21, 1889.

Relates to the construction of a switch plug and switch.

Telephone Transmitter, C. C. Hughes, Baltimore, Md., 542,444. Filed Sept. 12, 1894.

A multiple electrode transmitter in which the electrode has a cavity whose sections on planes perpendicular to the direction of motion are arcs of circles of gradually varying radii.

MANHEIM, PA.—A charter has been granted to the Manheim Light, Heat & Power Company; capital stock, $20,000.00. The directors are: Vance C. McCormick, Harry B. McCormick, Harrisburg; F. E. Bailey, Philadelphia; L. U. Bailey, Dillsburg; Robert A. Carl, Harrisburg. The plant will be built at once by F. E. Bailey & Co., of Philadelphia, and will consist of a combination steam and water power plant to drive the generators. The streets will be lit up and lights and power will be furnished to Manheim and vicinity.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE GRUTTING ELECTRIC SOLDERING IRON AND CURLING IRON HEATER.

GRADUALLY but surely the cleanliness and handiness of electric heating appliances is bringing this class of apparatus forward not only in manufacturing establishments but equally so in the domain of domestic economy. The ease and rapidity with which electric heating can be effected are additional strong points in its favor, and the accompanying engravings show two pieces of

FIG. 1.—THE GRUTTING ELECTRIC SOLDERING IRON.

apparatus which embody several novel features in this class of work, and which are the product of the Heilbron Brass Works, of St. Paul, Minn.

Fig. 2 illustrates their Grutting electric curling iron heater. As will be seen, the heater is suspended from an ordinary electric light socket, thus avoiding possible damage to furniture, as would be the case if the apparatus were mounted on a stand set on a table or stand. This mode of applying the apparatus also avoids the necessity of stringing a long flexible cord to the table, and hence makes it most convenient when travelling. In order to obtain the highest economy, the heating resistance is inserted in the curling tongs; this applies the heat in the right place, and when the tongs are ready for use, which takes about half a minute, the current is gradually reduced by means of a compensating resistance in the housing. This prevents overheating and brings the expense of running, down to a minimum.

The Grutting electric soldering iron, shown in Fig. 1, is

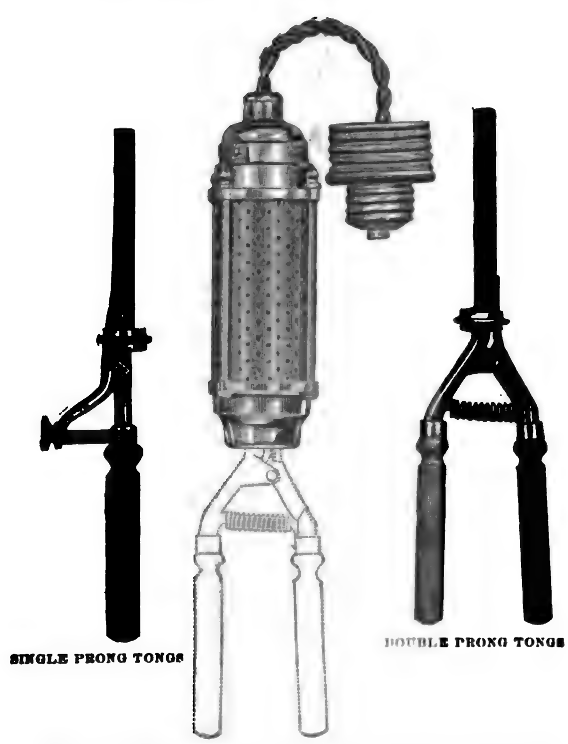


FIG. 2.—THE GRUTTING ELECTRIC CURLING IRON.

designed to afford a hot iron at all times. The heater is enclosed air-tight in a cast iron cylinder, and is made of an infusible material of which carbon is the principal constituent. Both the curling and the soldering iron are designed for 55 and 110 volt circuits. The soldering iron is made in three sizes, 1, $1\frac{1}{4}$ and $1\frac{3}{8}$ diameter, and provided with interchangeable copper tips, so that when one becomes worn another can be substituted at slight cost.

TESTS OF OKONITE BY DR. FLEMING.

The excellent qualities of Okonite have been so long known that it seems hardly necessary to adduce any more proofs of its high character as an insulating material. Nevertheless, consumers will be glad to learn that the high standard set for itself by the Okonite Co. is being maintained. This is fully established in the reports recently made by Dr. J. A. Fleming, the well-known author and Professor of Electrical Engineering in University College, London. We give below extracts from two reports.

Under date of December, 1894, Dr. Fleming reports:

The cables sent to me were in large coils of about half mile lengths, and came just as they were forwarded by the makers. * *

I have found in this Okonite Cable a very marked increase of insulation resistance with time of charging, and have, therefore, given all the results in the form of curves on a chart appended to this report, in which the insulation resistance of the samples is shown in megohms per mile of cable after one to five minutes' charging. * * *

My opinion of these cables is, therefore, that the Okonite material is a remarkably good insulator, and that the samples of Okonite Cable submitted to me represent a very high degree of excellence in the manufacture of insulated cable. I do not lay much stress on mere megohms per mile in a cable. The real practical test of a cable is the electrical pressure it will withstand after prolonged soaking in water, and such general rough usage as the the cable will experience in actual handling. In order to test the mechanical toughness of the Okonite material, I bent and kinked several samples at such sharp angles as to break the copper strand inside the Okonite insulation. This mechanical toughness combined with its flexibility is a great point in its favor.

I consider that this Okonite Cable is a very excellent and high class cable for all outdoor, overhead, or underground electrical work, with high electric pressures, whether alternating or continuous.

I regard it also as an excellent material for indoor wiring work, in cases in which the conductors are necessarily exposed to moisture, and under conditions in which a very large factor of safety must be employed. The standard copper conductor being tinned and twisted was not in a form suitable for a very accurate test of the copper conductivity, but the figures given for the resistance per mile of the Coils A, B and C, show that the copper employed is not less than 98% conductivity in all probability.

I consider that the behavior of these samples of Okonite cables places it in the front rank as a class of cable for electric lighting and transmission work.

Under date of Feb. 15, 1895, Dr. Fleming reports:

The next question to which I have directed my attention is the power of the Okonite material to withstand the action of chemical agents. For this purpose five samples of the Okonite cables were put to soak on January 12th, 1895, in the following chemical solutions:

(a) was put into strong Salt and Water.
(b) " " " Paraffin Oil.
(c) " " " Linseed Oil.
(d) " " " Caustic Soda Solution.
(e) " " " Dilute Sulphuric Acid, 1:10 or battery acid.

These samples were left soaking in these solutions until February 15, or for 34 days. They were then tested for insulation at 100 volts and found to be in excellent condition.

The samples were then submitted to the electric pressure test, the pressure being taken up to 3,360 volts by the use of an alternating current having a mean pressure of 2,400 volts, and all of these showed no signs of failure when exposed to this pressure for five minutes.

This forms an exceedingly severe test of the high insulating quality of Okonite, that after this soaking in oils, brine, acids and alkali for more than a month all the samples withstood 2,400 alternating pressure perfectly.

I have no hesitation, therefore, in saying that I think the Okonite insulation is a remarkably fine insulating material and one which by its electrical and mechanical qualities is well fitted for use in electric cables for high or low pressures. I have not found that the severe cold of the last month has rendered it at all brittle.

ELECTRICAL DISINFECTION PLANT FOR PHILADELPHIA.

A contract for the erection of an electrical disinfecting plant has been awarded by the Philadelphia Board of Health to the Excelsior Electric Company, with a bid of $2537. Director Beitler was requested to appoint an assistant disinfector to meet the demands of the service.

MR. WM. HUBBARD, so long and so well known in the field of telephony has withdrawn from the firm of Wm. Hubbard and Enyart, dealers in telephonic apparatus, and has taken the agency for the Gilliland Electric Co. of Adrian, Mich., for the State of Illinois. He will have his agency at Elgin, Ill., and will now devote his energies to pushing the Gilliland magneto telephones.

CARPENTER ENAMEL RHEOSTAT CO.

The Carpenter Enamel Rheostat Co. is one of the very few electrical concerns whose business has steadily increased throughout the recent business depression and which has paid regular dividends to its stockholders. The Carpenter Company has already paid 5 ½% on its capital stock during the present year, and its prospects are extremely bright. The Carpenter Co. is now filling orders for its electric soldering irons, curling irons, and disc heaters. Mr. Carpenter is giving personal attention to the introduction of these goods which are meeting with a very ready sale. H. Ward Leonard sailed for Europe on the "Paris," July 10th, to be gone several months. Mr. Leonard will represent several interests while abroad and will be able to accept commissions from parties in the United States desiring investigation of electrical matters on the other side of the water. His address will be care of Low's Exchange, 57 Charing Cross, London, E. C., England.

A PROMISING INVESTMENT.

The attention of practical investors and central station men or electric railway managers is called to the announcement of "C. K." in our advertising pages this week, relative to the opportunity of securing control of a combination plant. The station in question has been illustrated and described in THE ELECTRICAL ENGINEER, and we are of opinion that an excellent chance is presented to secure a property, the personal management of which should yield handsome returns. The references are of the best, and the closest inspection of the property is invited.

D'OLIER ELECTRIC CO.

The D'Olier Electric Co. has recently been formed at Philadelphia, with headquarters at 129 South Eleventh street. The members of the concern are W. L. D'Olier and Henry D'Olier, Jr. The company will make a specialty of electrical engineering and construction, as well as of repair work, and are ready to instal either a lighting plant or a telephone line or a call bell circuit. They will also undertake the care and maintenance of interior work and services for a small yearly fee.

WESTERN NOTES.

THE WALKER MFG. CO., Cleveland, O., through their Chicago representatives, the Messrs. Kohler Bros., have received the following order for the Sheboygan, Wis., Consolidated Street Railway Co., one 200 K. W. generator and 12 motors to be placed on six cars.

THE WESTERN TELEPHONE CONSTRUCTION CO. report the following sales: Chillicothe, O., 200 telephones installed, 100 more ordered. These are fully equipped with fire alarm telephone apparatus as well as being for commercial use; 100 telephones to Menominee, Wis. The Interior Department, Washington, are putting in telephones in addition to those already installed.

CHAS. E. GREGORY CO. have just issued the 1895 edition of their very neat and handy Electrical Telephone Directory. This little book fits nicely in the pocket, and as it contains the names, addresses and telephone numbers of all those who are interested in electrical matters in Chicago, as well as a list of the clubs and hotels in the city and several blank pages for notes, it is one thing that the electrical man cannot afford to be without.

THE ELECTRIC APPLIANCE COMPANY are securing some very pleasing results from the Upton arc lamps and have received a number of compliments. The direct and alternating constant current lamps appear to meet every requirement, and the regular series arc lamp is apparently filling the demand for a first-class series arc lamp at a low price. They have already placed a number of large orders for all their styles.

ATHENS, O.—Through the efforts of the eastern office of the Franklin Electric Co. the contract for a lighting plant at the Athens State Hospital, Athens, O., has been awarded to them. The plant will consist of two 60-horse power Russell Engines, 1–20 horse power Russell Engine, two multipolar 35 kilowatt Westinghouse dynamos and 1–15 kilowatt Westinghouse. 1200 lights will be used throughout the building and 6 arc lights on the grounds. The plant is to be completed on or before Nov. 1st, and the contract covers the complete installation.

METROPOLITAN ELECTRIC CO.—Business with the Metropolitan Electric Company, 186–188 Fifth Avenue, Chicago, in the fan motor line is very largely on the increase; they are doing a better business in this line than they have ever done before. Their Metropolitan incandescent lamp is giving excellent satisfaction and they are making large sales constantly. They call attention to the great reduction which they have made in the price of 12-inch alternating fan motors. There are but a few left, and orders should be sent in at once.

MR. C. G. ARMSTRONG has obtained the contract for the power plant of the Milwaukee Harvester Co., Milwaukee, Wis., which will be ready to start up on August 15th. This will be the first two-phase isolated plant in the West, and will consist of one 75 K. W. Westinghouse generator, 7,200 alternations per minute, 400 volts, and run at a maximum speed of 800 revolutions. The engine used will be a 110 H. P. Ball & Wood. There will be six Westinghouse motors used for the motive power of the factory, of the following sizes: One 30 H. P., one 20 H. P., one 15 H. P., one 10 H. P., two 7½ H. P.

THE RACINE, WIS., HARDWARE CO., have very good reason to feel quite jubilant. They are increasing their business all the time, and are running double shift at their factory. At the same time they are prepared for any emergency as the following goes to show. A short time ago their energetic Chicago representative, Mr. W. F. Parrish, Jr., received an order for one of their medium sized vertical engines at 4 P. M. The order was immediately telephoned to the works, where the engine was tested, boxed, delivered to the railway Co., arrived in Chicago at 5 A. M. the next morning and was delivered as soon as the purchasers were ready to receive it. This Co. have recently made the following sales: 8 outfits of marine engines and boilers to Buffalo, N. Y.; 2 marine engines to New Jersey, and quite a number to the western states. They will be pleased to send one of their handsome catalogues, with blue prints, and information to anyone interested in the class of machinery they manufacture.

PHILADELPHIA NOTES.

THE STANDARD UNDERGROUND CABLE CO., Pittsburgh, are building a large new brick warehouse. Business is good with them.

MR. CHAS. WIRT, formerly at 56 Fifth Ave., Chicago, has removed to Philadelphia, where his address is Ludlow, cor. 31st St. Queen & Co. have secured the right to the Wirt switchboard instruments and will manufacture these instruments in the future. Mr. Wirt is manufacturing his "non-sparking" dynamo brush and will shortly bring out a new brush intended for motors and dynamos, which are required to run with almost no attention.

PENN ELEVATOR CO., Bloomsburg, Pa., whose electric elevator was illustrated in THE ELECTRICAL ENGINEER last week has been in existence only a short time, but has already several plants in operation in different cities. It is making a specialty of the electric elevator, and is obtaining good results. It has an electrical plant in its own shops, whereby all elevators are tested before shipment. It is thus able to guarantee its customers excellent work. The officers of the company are Paul E. Wirt, president; L. E. Waller, vice-president; P. S. Harman, treasurer: C. C. Peacock, secretary and H. G. Sherwood, manager. The Philadelphia office is at 43 North Seventh street.

NEW YORK NOTES.

THE INTERIOR CONDUIT & INSULATION CO. are very busy equipping summer theatres with Lundell fans.

ATLANTIC CITY, N. J.—The Atlantic Electric Light & Power Co. has, Supt. Fowden states, a total capacity now of no less than 8,500 incandescents and 620 arcs. It has just put in a new Kensington engine to run three dynamos, a new Buckeye, Sturtevant blower, and some new General Electric dynamos.

MR. S. F. B. MORSE, the Kerite man of Chicago, paid New York a visit this week, and received a hearty welcome from his numerous friends in this city. Mr. Morse is chairman of the entertainment committee of the North Western Electric Light Association, which has its convention at the Leland House, Chicago, on July 17, 18, 19, and will be glad to see a large contingent from the East in Chicago at that time.

MR. C. M. MAXWELL, formerly of Portland, and now of San Francisco, who has been for many years prominently identified with electrical work, has recently severed his connection with the local Edison Company in San Francisco in order to devote himself to several important interests which have been placed in his hands. Mr. Maxwell who was in New York last week for the purpose of closing arrangements for the representation of some leading New York houses on the Pacific Coast, has left for home.

NEW ENGLAND NOTES.

MR. A. G. LAIDLAW for many years in the electrical business in Boston, has accepted a position as superintendent for the Philadelphia Electrical Equipment Co., of Philadelphia, Pa. Mr. Laidlaw has been connected with the New England Electrical Co., the General Electric Co., and has recently been with Frank Ridlon & Co., and leaves with the best wishes of his late employers.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

Vol. XX. JULY 24, 1895. No. 377.

CANADIAN WATER POWER SCHEMES AT NIAGARA, MONTREAL AND TORONTO.

NOW that the wheels of the Niagara Power Company have been actually set in motion on the American side at Niagara Falls, and the success of the undertaking is no longer a matter of conjecture, plans are rapidly maturing for the utilization of other water powers. Besides the work shortly to be begun on the Canadian side of the

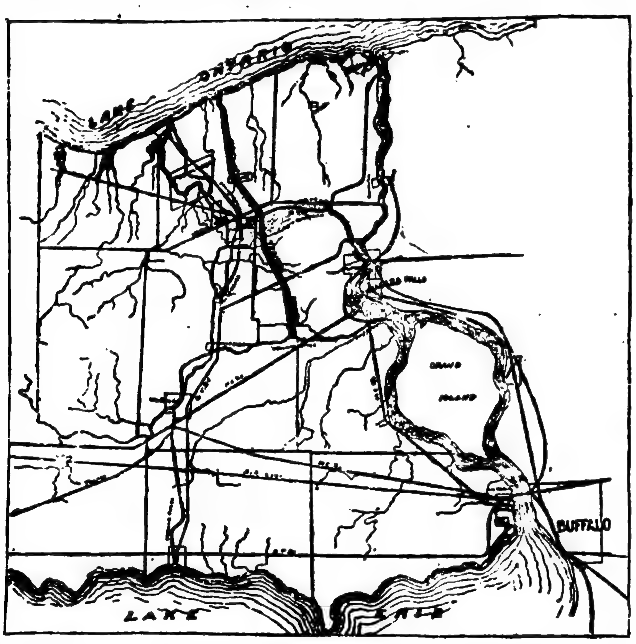


FIG. 1.—PROPOSED POWER CANAL FOR WELLAND POWER AND SUPPLY CANAL COMPANY.

Horse Shoe Falls, the plans of which were illustrated in THE ELECTRICAL ENGINEER, issue of June 26, a number of other water powers are proposed for utilization in Canada, some involving powers even greater than that on the American side.

The first of these to claim attention owing to its proximity to Niagara is the scheme of the Welland Power & Supply Co. (Limited) which was incorporated at the last session of the Dominion Parliament, and whose aim is not only the utilization of power but also to supply water to irrigate the peninsular fruit belt. The charter of the company permits it to draw unlimited water from the Niagara River. The company is empowered to deepen or widen the Chippawa Creek from its mouth to the point of intersection of the proposed canal, four and one half miles west, and it is said there is nothing in the charter to prevent the company from diverting the course of the Niagara River to Thorold, Ont.

As shown in the accompanying map, Fig. 1, the company propose to take the water through a widened and deepened channel in the mouth of the Welland River, and at a distance of 4½ miles from the Niagara River. The water is to be taken through a surface canal 100 feet wide at the bottom, 150 feet wide at the top, and 15 feet deep, and will be carried by one level open cut through clay to the escarpment near the town of Thorold, a distance of about 6½ miles, to the brow of a mountain, with a drop of only 10 feet from the level of Lake Erie, giving an available fall of 320 feet to the level of Lake Ontario. It is proposed to locate the first turbines 150 feet below and then to carry the water by a series of falls, each generating power, to an open canal or raceway emptying into Lake Ontario, 6½ miles away. The profile of the course taken by the water is shown in the engraving, Fig. 2. On the mountain top at Thorold it is proposed to build a lateral canal long enough to feed 60 turbines, each of 5,000 H. P. capacity. Mr. Chas. A. Hesson, collector of inland revenue at St. Catharines, Ont., one of the prime movers in the company, claims that the proposed plan will make it possible to deliver power at Fort Erie, Ont., at the very door of Buffalo, for $6 per horse power per annum.

The enterprising city of Toronto is also to be the scene of a power transmission scheme with the source of power barely beyond the city limits. The plan to be adopted is illustrated in the accompanying map, Fig. 3. The Georgian Bay Ship Canal & Power Co. is about to begin operations in the Humber Valley about 1½ miles above the mouth of the Humber River. At Baby's Point, on the farm of Mr. Frank Baby, a dam will be thrown across the river, which will form a great reservoir, the fall from which will be utilized. The dam will be 140 feet high; length at base, 444 ft.; length at summit, 838 feet; thickness at base, 80 feet; thickness at summit, 20 feet. With the erection of the dam at the point indicated, a lake about six miles in length, with an average width of one mile will be formed. No other embankment will be required. Some idea of the magnitude of this great reservoir may be gathered from the fact that a six months'

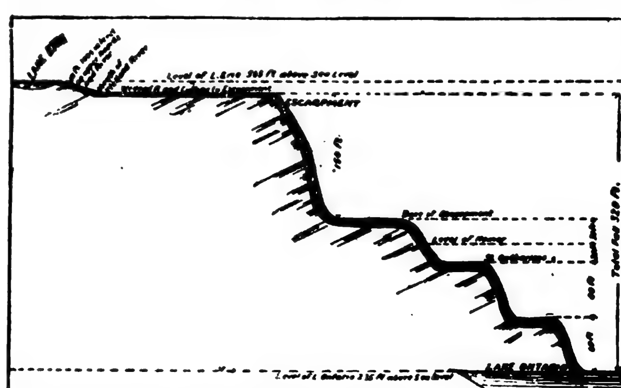


FIG. 2.—PROFILE OF COURSE TAKEN BY WATER, PROPOSED POWER CANAL.

supply can be taken from it during the dry season without reducing the level below the point of efficiency (120 feet).

According to the report of the engineer, Mr. Kivas Tully, C. E., the Humber drains 562 square miles, the surplus water from the watershed amounting to 23 billion cubic feet annually, or averaging over 400 million gallons daily. This water, by the construction of dams at intervals along

the basin, can be used at various heads so as to secure a total fall of over 450 feet on the average, and the energy thus derived is capable of developing 91,459 horsepower, gross, for ten hours each day, or 68,595 electrical horse-power, net. If section "A" alone were built, a head of over 140 ft. would be had on the first dam, and with the daily average supply of water this head would give 10,668 horse-power immediately. Every dam and reservoir constructed up stream would add to this, so that out of the Humber alone over 68,595 horse-power could be taken ten hours daily. The addition of the Lake Simcoe and Black River waters to this would increase the electrical horse-power per ten-hour day by 250,974, or a total of 319,569 horse-power.

The 10,668 H. P. immediately available would be sufficient to generate current to supply all the power required in West Toronto Junction and the western part of the city and move all the electric cars in the city. About $350,000 will be required to cover the land damages and cost of properties appropriated. The construction of bridges, the deviation of roads and the building of the dam will not exceed $375,000 more, or a total for the whole work of $725,000. This is said to be a liberal outside estimate. To this will have to be added the cost of the power house and plant.

Besides the enterprises just described we may add another which has long been contemplated, but which has only recently taken definite shape, and that is the utilization of the Lachine Rapids, about 5 miles above Montreal.

The plan which it is proposed to follow is illustrated in Fig. 4. At the upper end of the dam, projecting above the water, is the triangular ice-guard protecting the timber

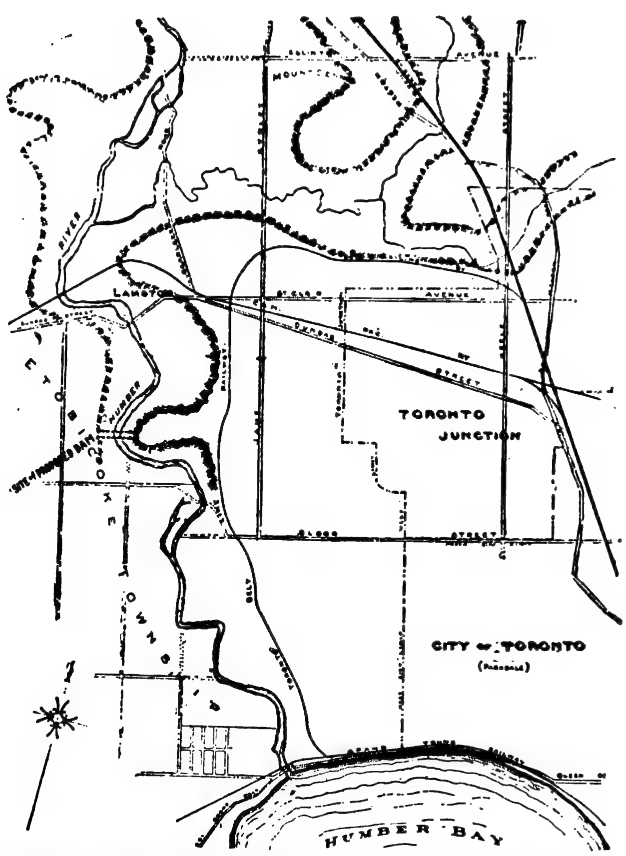


FIG. 3.—PLAN FOR UTILIZING POWER OF HUMBER RIVER, TORONTO.

dam. The dam from this for about 1000 feet will always be under water, and it is over this over-fall that it is proposed to discharge the floating ice. Below this over-fall for 1800 feet the dam rises somewhat higher and will only overflow at high water, its object being to control the head or keep the power constant. From this point to the main dam the crib work will be raised high above the greatest known flood, and from the main dam down stream it will be continued some distance, but at a lower level to form an ice-guard and prevent the ice entering into the tail race.

To utilize the power thus formed a dam will be thrown across at the foot and will consist of isolated piers somewhat resembling bridge piers, and between these piers will be placed wheels and shafting. On these piers the

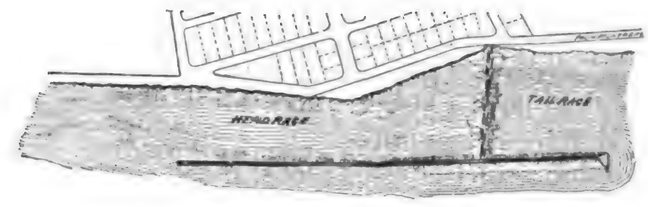


FIG. 4.—PLAN FOR UTILIZING POWER OF THE LACHINE RAPIDS, NEAR MONTREAL.

dynamo houses, shaft sheds and bridge will be constructed. From Lake St. Louis to the harbor of Montreal there is a fall of some forty-four feet; of this the Company utilize only eight feet. They intend to put in sixty-six 61-inch turbine wheels, which under an 8-foot head, should give 120 horse power each, or a total of 7920 horse power. Tenders for the construction of the work have already been called for.

THE EFFICIENCY OF HEATERS.

The German Hygienic Association, offers a prize of $1200 for a research essay on the heat given out by heaters. The programme is: "The heat given out in heating installations by heaters in their various forms and modes of use is to be ascertained. The investigations are to be described in detail in respect to the arrangement of the heaters, the nature of the heating agents and the observations made; and they are to be illustrated by drawings. The heating values obtained are to be stated in units of heat given off per hour per unit of surface. In the case of heat given out to air, the investigations must be conducted with currents of air at speeds as different as possible. The heaters are to be described in detail as regards form and measurement, and the relation of their heating efficiency to their weight is also to be ascertained." Essays to be written in German, with a motto and sealed envelope, and sent to Prof. Konrad Hartmann, Charlottenburg, Fasanenstrasse 18, before July 1, 1896. The essay will remain the property of the successful competitor, but he must publish it within six months, and give the prize offerers 300 copies gratuitously. The prize may be divided or withheld.

ELECTRIC LIGHTING AT BERLIN.

In the annual report of the Berlin Town Council on the administration of the municipal gasworks, some interesting figures are given in regard to electric lighting in Berlin. There are in all 185 street arc lamps, 71 of which are alight all night, the remainder only burning up to midnight. For private purposes there are 9,932 arc lamps, 200,474 glow lamps, and 667 motors and apparatus. Of these, 4,259 arc and 79,212 glow lamps are supplied by isolated plants, of which 251 are driven by steam and 97 by gas engines. Current for the remainder is supplied by the Berlin Electricity Works. The increase of the lamp connections over those connected at the end of the previous year (1893) was 16·23 per cent.

REPAIRING UNDERGROUND TELEGRAPH CABLES IN WEST AFRICA.—A UNIQUE ENGINEERING EXPERIENCE.

NOT the least important part of an engineer's equipment for his work is the ability to write reports of the operations entrusted to his charge. And, conversely, such reports are very good criteria of their author's capability, or otherwise, to cope with the responsibility conferred on them. A man who carries out work involving interests and expenditures of any importance without making a thorough report, or, as often happens, without making any report at all, to those ultimately responsible is clearly not

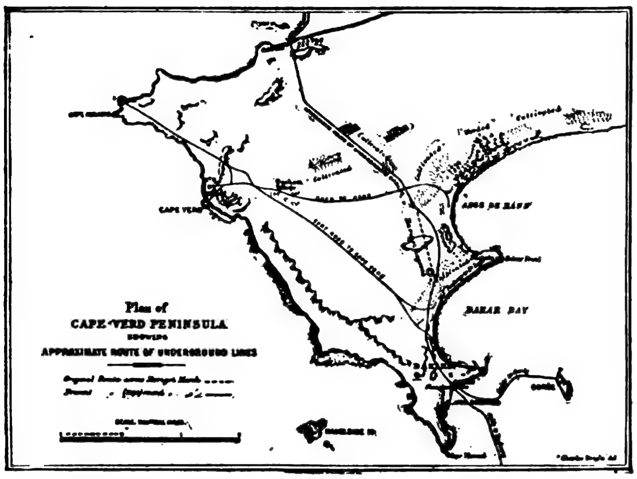


FIG. 1.—MAP SHOWING ROUTE OF YOF-DAKAR CABLES.

up to the level of his calling; while from a detailed report a very satisfactory index is obtained of a man's grasp of his work—apart altogether from the value of the report as a record of the work accomplished and as a guide for the conduct of future operations. And the value of such reports increases as the square of the distance of the scene of operations from headquarters. These few abstract reflections are suggested by the reading of a book of about 100 pages (with various maps and diagrams) entitled: "Reports on Yof Bay-Dakar Cable Repairs and St. Louis Beach Cable Repairs, 1893," by Charles Bright, Assoc. M. Inst. C. E., M. I. E. E.

The report is published, in accordance with that Company's practice of printing the complete logs of its cable expeditions, by the India Rubber, Gutta Percha and Telegraph Works Company, of Silvertown, England, of whose submarine cable engineering staff Mr. Bright is a member.

It will not have escaped the attention of our readers, by the accounts given in THE ELECTRICAL ENGINEER, of the action of the Commercial Cable Company in landing their cable directly on Manhattan Island in order to avoid the uncertainty of land line communication with the former terminus at Coney Island, that submarine cables are often subterranean cables and that the subterranean portions of a submarine cable system are generally more prolific in trouble than the submerged portion of the line. Such seems to have been signally the case with the land lines Mr. Bright was sent to repair, and to the reluctance of those lines to remain in working order for any length of time we are indebted for his interesting narrative of an engineering work of quite unusual nature, carried out under very harassing and discouraging conditions.

Yof Bay and Dakar are two points on the coast of Senegal about 100 miles south of St. Louis, the capital of that French West African colony. From Yof Bay a section of submarine cable parts northward to St. Louis and from Dakar a section parts southward to Bathurst. To complete the line between the two points, the choice lay between a section of heavy cable to be laid well out to sea round a rocky peninsula or a landline across the neck of the peninsula, a distance of about eight statute miles. The latter course was chosen when the submarine cables were originally laid, in 1885, and accordingly two lengths (one spare) of submarine cable were buried in a trench between Yof Bay and Dakar.

Mr. Bright's introduction to these lines came about in February, 1893, when he was detached, at Santa Cruz de Tenerife, from the Silvertown Company's steamship *Dacia*, homeward bound from a repairing expedition in the South Atlantic. Mr. Bright was landed with two cable hands, a jointer, a knot and a half of submarine cable and sundry other stores, and with instructions to proceed to Dakar and repair those land lines. Which he did; and his detailed report of what he found to do and how he did it all forms one of the most interesting records of unconventional electrical engineering experience that we have met with for a long time.

To begin with, even if Mr. Bright's work had had to be done under civilized conditions, instead of in a murderous climate and with a slender amount of skilled help and insufficient equipment, he would have had no easy job on his hands. For those Yof Bay-Dakar cables had a sinister record for a short line of only eight miles. Laid down in 1885, they were repaired in 1886, again in 1889, and again in 1890 or '91 and were once more in a completely demoralized state early in 1893. Indeed, so sinister was the record that much of it had been left unwritten, as those in charge of two of the repairing expeditions had made no note nor report of their work to serve as a guide to Mr. Bright in his operations. Moreover there were no marks along the route of the line, which passed at one point through a marsh the dimensions of which varied accordingly to wet or dry season, the only map of the route being in

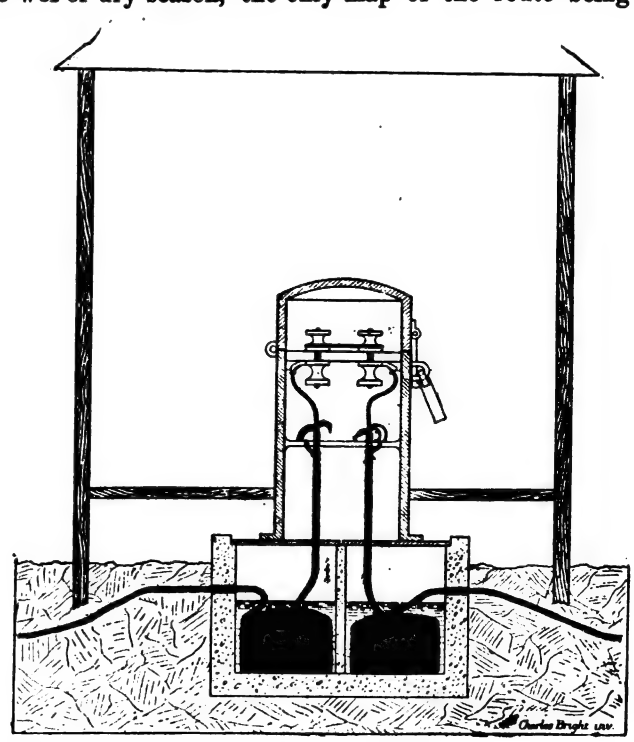


FIG. 2.—BRIGHT'S IRON BOX AND CEMENT TANK FOR CABLE ENDS AT HUT.

the memory of a native guide named Ahmadon, who had served on the previous repairing expeditions. Ahmadon, then, had to serve as compass, sextant, pilot and chart, and he did fairly well, even to freely confessing his ignorance when he really did not know where parts of the line were situated.

Not every young engineer sent to carry out such a very discouraging piece of work would have acquitted himself as well as Mr. Bright did. His preliminary tests showed

both cables to be dead grounded in various places. His subsequent investigations showed that flagrantly bad work had been done before, that the cables were laid at several points in dangerous situations; and the mechanical condition of the cables wherever they were dug up was found to be hopelessly bad. There were no marks of positions, no chart of the route and no accurate record of previous operations. In a few days over a month Mr. Bright relaid a considerable portion of the line, safeguarding the dangerous spots, made a large number of new joints, brought up the insulation of both lines to a working point, 2 megohms per mile, marked out the whole length with iron posts, placed 250 yards apart, marked every joint with stone pillars, prepared an accurate chart of the route of the lines and executed sundry minor repairs to the huts at the two ends of the line, besides executing, by way of diversion, some tests and repairs on the sea sections at St. Louis, a hundred miles distant from the scene of his main operations.

Mr. Bright narrates in great detail the entire course of his work and gives some interesting particulars as to the behavior of gutta percha and insulated cores under tropical conditions, besides adding numerous suggestions aimed to secure a greater measure of durability for future underground telegraph lines. Of the report itself, as a report, it is not necessary to speak further except to say that it reveals considerable organizing ability on the part of its author by the particulars Mr. Bright gives of his superintendence of the work, of his measures to preserve the health of his staff and to maintain good relations with the native authorities and with others who might in any way have influence over the fate of the cables; the report as a whole provides Mr. Bright's employers with a complete and accurate survey of the line and of the condition of the cables.

It appears that part of each line consists of gutta percha and part of india rubber core. Both seemed to have fallen into similar conditions of decay. The india-rubber cable was laid across the marsh already referred to; of its condition Mr. Bright speaks as follows: "Wherever the cable was picked up and opened out here (in the works) the india-rubber was found to be in a perfectly pulpy state, not unlike putty, size, or the original condition of the india-rubber gum when first collected." It seems that the india-rubber cable was put down in the marshy ground on previous repairs because such cable is believed to stand alternations of temperature and humidity better than gutta-percha; Mr. Bright suggests that the failure of the core to act up to its reputation in this case was due to imperfect vulcanization. As a matter of fact, however, no rubber core could be expected to long maintain its insulation under the conditions of alternate moisture and dryness and high temperature without better outer protection than is afforded by the serving and armoring of a submarine cable.

The following is the account given of the condition in which the gutta-percha core was found at the joints and at kinks where the cable was picked up: "At almost every part of the line that I had occasion to disturb I found both the cables subject to a succession of kinks, causing the sheathing wires to 'bird-cage,' and in many instances leaving the core entirely exposed, the gutta-percha in consequence gradually crumbling away in a white, chalky state, the conductor usually being left bare in places and in some instances making contact with the sheathing wires." In the 32 joints that Mr. Bright cut out he found the gutta-percha invariably in a completely decayed condition, leaving the conductor bare in places. The joint itself as a rule was in fair condition but the core on either side was always in a completely perished state, the gutta-percha gradually dropping off in a white, chalky form, after having rotted away to "needle-points." Speaking again of the deterioration of the gutta-percha Mr. Bright says: "The condition of the gutta-percha in the lines was found to be principally of the dry, cracked, chalky description already alluded to, but in places it was also found to be in a 'tacky' state, not unlike treacle, and it was soon found to be impossible to make anything like a respectable joint with gutta-percha in this state."

That with cables in this state and all the added difficulties of marshes, travelling sand hills, gullies, and other obstacles, tropical heat and tropical labor and the disadvantage of an insufficient stock of new material Mr. Bright succeeded in effecting creditable repairs and in leaving the lines in working condition speaks well for his skill and perseverance. We trust for his own sake that when the Yof Bay-Dakar line next needs attention he may be otherwise occupied in less arduous and trying work.

At the end of his report Mr. Bright summarizes a number of points which naturally occurred as a result of his experience. He would eschew joint boxes in buried cables in favor of regular splices; and he condemns spare coils of cable at joints as sources of trouble. He also protests against the use for land lines of strained cable that has been recovered in deep sea repairs. He thinks india-rubber core on the whole more suitable for land line work than gutta percha. Among a number of suggestions bearing on general details of the work the one of most practical bearing as a principle is that advocating the use of a cable with air-tight casing instead of cable of the ordinary submarine type. On this point Mr. Bright is a little over cautious where he hazards "even a hermetically sealed lead-covered cable," for this is undoubtedly the thing that should be used, and no better proof is needed than Mr. Bright's description of the condition of the gutta percha and india-rubber cables on the Cape Verd peninsula after a much interrupted life of less than eight years. To bury anywhere except deep down in permanently damp and cool ground a non-leaded cable is simply to invite deterioration of the core and expensive interruptions and repairs. Lead-covered cables with an outer protection of flat iron wires or strip properly buried would be practically indestructible and everlasting in spite of alternating temperature, dry sand or wet marshes.

The cement storage tank and iron box which Mr. Bright proposes for making fast and protecting the cable ends at a cable hut is undoubtedly a good idea and shows his predilection for a thoroughly workmanlike job; the expense and inconvenience of such construction at the situations in which cable huts are generally established will probably militate against its adoption.

H. L. W.

ALUMINUM-COPPER TELEGRAPH WIRES.

Tests have recently been made of some aluminum-copper wires intended for use in connection with the Monteil Trans-African Expedition. The percentage of the alloy composing these wires is 40 per cent. aluminum and 60 per cent. copper. The resistance of a kilometre of these wires having 1mm. cross-section is found to be 31·1 ohms for soft and 33·29 ohms for hard-drawn wire, the resistance of an ordinary copper wire of the same dimensions being 16·45 ohms. The tensile strength of wires of this alloy, 2·3mm. in diameter, was found to be, on an average, 28 kilogrammes per square millimetre (17·78 tons per square inch).

GOVERNMENT TELEGRAPHY IN TURKEY.

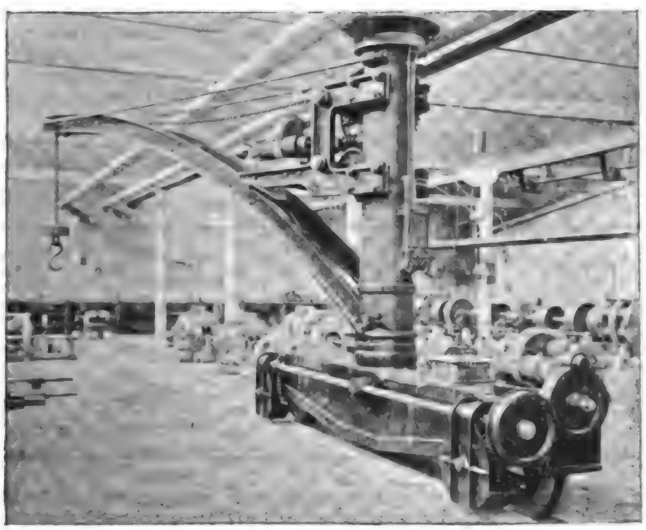
The London correspondent of the *New York Sun* writes: "I have seen to-day an amusing official note from the censor at Constantinople. It is addressed to a well-known correspondent and says that in order to make a message more accurate and explicit he added ten words to the latter's telegram the previous night, and asks the correspondent to send along $2 to pay for the added words. It is useless to protest in Turkey, so the correspondent sent the money, but at the same time respectfully suggested that if the censor would write his message entirely and merely forward him the weekly cable bill it would save him much unnecessary trouble. The censor is taking time to consider whether this offer is serious or sarcastic."

HENRION ELECTRIC JIB CRANE.

THE accompanying illustration represents a crane installed in the works of M. Fabius Henrion, the well-known electrical manufacturer, at Nancy, France. The crane traverses one of the shops having a length of 260 feet, and has a reach of 16½ feet, and is, therefore, able to cover an area of 260 by 32½ feet. The crane has a capacity of six tons, and takes the castings as they arrive and swings them successively into the various machine tools, from there to the assembling, then successively to the testing, painting and packing departments.

The crane is guided below by a single Brunel rail, and above by two H beams, below which are fixed two conductors, from which current is taken by friction contacts.

The motor placed on the carriage effects the traversing



HENRION SINGLE RAIL ELECTRIC JIB CRANE.

of the crane. This movement is controlled by the regulator beside the dynamo; it only requires the turn of a handle to the right or left to go forward or backward and slower or faster. The reversing of the crane movement is obtained by the reversal of the current in the field magnets. The brushes of the dynamo are of carbon and remain absolutely fixed under all conditions of working. The motor is placed on a bracket attached to the vertical column and jib and operates the raising and lowering movements, and is controlled by a regulator fixed to the column. When the load descends the motor is converted into a dynamo and acts as a brake.

LITERATURE.

Extracts from the Private Letters of the late Sir William Fothergill Cooke, 1836–39, Relating to the Invention and Development of the Electric Telegraph; Also a Memoir by Latimer Clark, Esq., F. R. S., Past President Inst. E. E. Edited by F. H. Webb, Sec'y Inst. E. E. London and New York. E. & F. N. Spon, 1895.

ORIGINAL contemporaneous correspondence, written with an immediate and without an ulterior purpose in view, constitutes, when accurately reproduced and impartially edited, the very best of historical material. We are therefore grateful to Mr. Webb for giving us in this tasteful little volume, a reprint of a considerable number of letters written by William Fothergill Cooke, mostly to his mother and other family friends and relatives. The series commences at the time when, a medical student at Heidelberg, he first conceived the idea of a practical electric telegraph, which in his first letter to his mother dated April 5, 1836, he says was "some weeks since," down to a date subsequent to the successful establishment of the first operative telegraph line between Paddington and Drayton, late in 1839. The hopes and fears of the young and enthusiastic inventor during these fateful three years are vividly portrayed, and incidentally, many items of interest relating to the early history of the telegraph in Great Britain may be gleaned from these letters. June 8, 1838, Cooke writes to his mother:—"I have just tried a fresh series of experiments to the extent of nearly 40 miles, and with more satisfactory results than before. Therefore to anticipate a failure would be absurd." On this letter is the following endorsement in the handwriting of his mother:—"God be with my blessed boy, and prosper this mighty discovery"; a sentence worthy to take its place in the annals of the telegraph beside the historic despatch with which Morse, in 1844, opened his Washington-Baltimore line—"What hath God wrought?"

The appended memoir of Cooke by Latimer Clark is reprinted from the proceedings of the Institution, in which it was published in 1879. It could have been wished, in the interest of the truth of history, that the editor might have seen fit to correct by annotation, or otherwise, certain statements of Mr. Clark which betray far more regard for national prejudice, than desire to ascertain and state the truth in reference to certain controverted facts. Thus on page 91, after referring to notices of various European experiments in telegraphy which had been published and circulated during the year 1837, and also to Morse's letters to the *Journal of Commerce* of September 4, and to the Secretary of the Treasury on September 27, 1837, Mr. Clark says: "From these letters it is sufficiently evident that the American Telegraph grew out of the efforts of Messrs. Cooke & Wheatstone and other European telegraphers, and that there is no ground for that claim of priority which it has sometimes been endeavored to set up." He also intimates, on the authority of Dr. Hamel, that the reason why Cooke and Wheatstone could obtain no patent in this country was "because the chief of the Patent Office was a friend of Professor Morse." The inexcusable malignity of this utterly false insinuation will appear from the simple statement that Cooke and Wheatstone not only *did* obtain a patent in this country, and this so far as appears, without the slightest opposition from Professor Morse or anyone else, but their patent was granted, as the published records of the Patent Office show, before that of Morse.

There is abundance of unimpeachable evidence, with which Mr. Cooke's biographer could not but have been familiar, that the apparatus which Morse exhibited in New York in successful operation on the 2d and 4th of September, 1837, had been in all its principles and essential details, devised on board the Sully in 1832. The *invention* must have been made at some time before it was possible to give it a mechanical embodiment, and the date of that invention, so far as Morse's original apparatus was concerned, was 1832, as testified to by the captain of the vessel and confirmed by a large number of his fellow-passengers, in the telegraph suits fifteen years later. It is true that Cooke and Wheatstone had a commercially working line in operation before the end of the year 1838, while Morse did not accomplish the same thing until six years later, but that is surely insufficient ground for the positive assertion of Mr. Clark that the invention of the latter "grew out of the efforts of Messrs. Cooke and Wheatstone." The Secretary of an institution like that of the Electrical Engineers, owes it to himself not to let such unwarrantable insinuations and mis-statements pass under his editorial supervision unnoticed and unchallenged.

F. L. P.

Municipal Ownership: Its Fallacy. By M. J. Francisco. Fourth Edition. Paper cover. 100 pages. Pub. by the author. Rutland, Vt.

Addressing himself once again with undiminished zest to the fight against the municipal ownership of electric lighting plants, Mr. Francisco has brought out another edition of his pithy and effective pamphlet, revised up to date. The merely argumentative part of the test is now supplemented by a number of legal and editorial opinions on the subject, as well as by useful tables showing the real cost of lights as furnished by private companies and municipal plants.

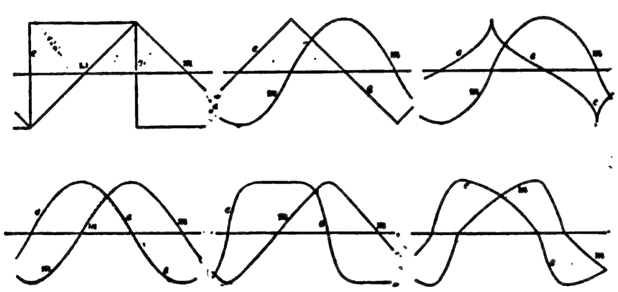
Such literature cannot have too wide a circulation. The tendency to divert public funds raised by taxation into the channels of specific commercial enterprises is strongly pronounced, and it is based upon the fallacious supposition that by means of such expenditures, cities can add to their income and also lighten the general burden of taxation. The theory is pretty but it rarely works out well. Mr. Francisco, who has made a close study of all points of the subject, holds that no municipal plant can pay; at least we believe that to be his bottom conviction on the subject. It might be admitted that one or two plants of this nature are profitable, and the argument against them remains as strong as ever, for some of the instances to the contrary present failures that are simply stupendous. Indeed, it is one of the saddest spectacles of modern times to see how the load of public indebtedness is growing in the various civilized countries, and quite as much from state and municipal enterprises as from preparation for war. If the standard of performance improved with the increase of debt, there might be some consolation, but the various recent investigations in different cities reveal waste, extravagance, mismanagement and dishonesty that are positively appalling.

ALTERNATING CURRENT CURVES.[1]

BY CHARLES E. EMERY, PH. D.

The paper refers preliminarily to the facilities for general investigation available when the variations in magnetism, electromotive force and current, in alternating current apparatus, are assumed to be accurately represented by sine curves. It states that the methods are strictly applicable for such curves only, though very valuable practical results have been obtained for other curves by special methods involving "equivalent sine curves" and a modified or "equivalent angle of lag." The paper urges that it is therefore desirable to develop a general system for formulating and integrating the value of the "instantaneous watts," applicable to curves of different shapes, which will include an approximate sine curve as a special case. Such a system should avoid the necessity of using equivalent values and enable the distortions of alternating current curves to be explained directly by formulating the conditions which produce the same instead of considering arbitrary "harmonics."

In order to accomplish this it is first necessary to develop a general formula which will approximately represent curves developed in practice. The E. M. F. is at first assumed as proportioned to a function represented by the variable base x raised to a power which is constant for each particular case developed. The integral of this equation referred to the same origin gives values proportioned to the corresponding momentary magnetic flux. Curves based directly on the primary function are illustrated to show its remarkable features, though stated to be not as well applicable to represent alternating current curves as the equations of the second series in which the primary function is subtracted from a constant bringing the origin at zero of magnetization The differential and integral equations thus developed are divided through by the maximum ordinate and multiplied by s, representing the base for one-fourth period, to bring all values in terms of



FIGS. 1, 2, 3, 4, 5 AND 6.

a uniform base, when the resulting equations of Series II. take the following form :

$$e = s - \frac{x^u}{s^{u-1}} \tag{11}$$

$$m = \frac{u+1}{u\,s^u}\left(s^u\,x - \frac{x^{u+1}}{u+1}\right) \tag{12}$$

in which u is a partial exponent constant for each particular curve developed.

If $u = 1$, as shown in Fig. 2, the curve of E. M. F. or e becomes a triangle and the curve of magnetization m a parabola, showing that the values for partial exponent, u = unity, are for both series of equations identical.

As shown in Fig. 3 for which $u = 0.5$ for values of u between unity and zero the curve e takes a cusp form and the curve m a rounded form. If $u = 2$ both curves e and m, as shown in Fig. 4, approach the sine form represented in dotted lines, the curve e being a parabola slightly greater in area than a sine curve and the curve m consequently of slightly less area than a sine curve.

By using a fractional exponent both curves can be brought still closer to the sine form. For $u = 1.781$ in Eq. (11) the square root of the mean square of the ordinates of the resulting curve e is 7.071 or the same as for the sine curve. The two curves being derived from different functions cannot absolutely coincide, but the differences are so slight that to find them the values must be extended to several decimal places, and, in plotting, the curves seem identical. If the value of u be still more increased the curve of magnetization m rapidly approximates the shape of a triangle and the curve e of E. M. F. approximates a rectangle, so that doubtless for u = infinity, the curve would take the form shown in Fig. 1.

The change above indicated is so rapid that for $u = 6$, as shown in Fig. 5, the curve e has already taken the general shape of a rectangle with well rounded corners, and the curve m the general shape of a triangle with rounded point. The curve e resembles closely the curve of electromotive force given by a dynamo from which armature reaction has been eliminated, as shown in a recent paper,[2] and the corners may be made still sharper by increasing the value of u.

Unsymmetrical curves based also on $u = 2$ in Eqs. (11) and (12) are shown in Fig. 6. These curves are plotted with the same values of the ordinates as in Fig. 4, but the portion of the curve showing decreasing magnetism and increasing E. M. F. is plotted in a distance less than a quarter period, and the remainder of the curve in a distance greater than a quarter period, so that the sum of the bases equals one-half period. These curves show that the phase relation of curves m and e may be changed simply by the shape of the curve m of magnetization. The plus and minus branches of this curve must be similar and of equal area, but the change of magnetism and of electromotive force during the increase of the latter need not be at the same rate as during the decrease.

It will be observed that this very large variety of curves are finally derived from two simple algebraic equations for each series, those for Series II. being given in Eqs. (11) and (12). The first equation of each series is the differential equation of the second equation of that series, but the integration required to pass from the first to the second is already performed, the equations are complete and may be utilized at once by simply substituting numerical values.

The distinguishing features of the different curves are shown in the following table :—

DISTINGUISHING FEATURES OF THE DIFFERENT CURVES.

General Shape of Curves of E. M. F. and Current.			$\sqrt{\text{mean}^2}$ in scale of 10	Relative Ratio Max. to Effective Voltage.
Triangle........................	$u = 1$	Fig. 2	5.774	1.732
Sine Curve..........................	—	—	7.071	1.414
Approximate Sine Curve.......	$u = 1.781$	—	7.071	1.414
Parabolic Curve	$u = 2$	Fig. 4	7.303	1.369
Approximate Rectangle.........	$u = 6$	" 5	8.895	1.124
Rectangle..........................	$u = \infty$	" 1	10.000	1.000

The paper then shows curves of E. M. F. and current differing in phase, and develops methods for obtaining the ordinates of these curves from the same origin for any desired angle of lag. The equations of the momentary values of E. M. F. and current are then multiplied together and integrated, giving diagram watts which are stated for various differences of phase.

The paper points out that by this method it is possible to use a different function for descending and ascending branches of the curves, thus producing unsymmetrical curves, and yet perform the integration and that this function may be developed by imposing upon the original function another function based on the actual conditions which produce a certain change so that the curves finally resulting will include all the conditions. The paper states that it has been pointed out that the observed distortions of alternating current curves may be illustrated by imposing upon the primary function a series of harmonics, but to make such a method strictly rational it must be shown that each condition, if formulated, will produce the equations of such a harmonic, and continues that it is not probable that such is the case, but that the method proposed gives facilities for considering the general conditions whatever the shape of the curves that will represent them.

In the discussion of the paper by Prof. Pupin and Mr. Steinmetz both deprecated the tendency of mechanical engineers to use empirical formulæ and claimed that such formulæ were unnecessary, as rational formulæ were already available, since by the application of different harmonics curves of various shapes could be produced. Dr. Emery, in response, claimed that the curves he had developed were no more empirical than the sine curve, since the actual curves were rarely exact sine curves. Moreover the actual shape could be represented by his system without resorting to harmonics, and the modification due to conditions could be impressed upon equations in the form he stated them, by multiplying such equations by other equations representing such conditions. He believed that the method of investigation by means of actual momentary values would meet with increasing favor and considered the equations given as, in effect, tools to assist in the prosecution of a higher order of investigation.

DETROIT, MICH.—The Wolverine Electric Co. has been organized, with a capital of $10,000 for the manufacture of specialties and supplies and construction work. Its officers are G. A. Brooks, president, C. F. Scott, secretary and treasurer, and Hiram Marks, general manager. It has a 150 light machine.

1 Abstract of a paper read before the American Institute of Electrical Engineers, Niagara Falls, N. Y., June 27, 1895.

2. Prof. H. J. Ryan and Mr. M. F. Thompson on "A Method for Preventing Armature Reaction," *Trans.* Am. Inst. Elec. Engrs., March, 1895.

ELECTRICAL WORK AT THE ATLANTA EXPOSITION.

The Atlanta Exposition, which is to be opened to the public on September 18, is rapidly assuming definite shape, and commissioners are arriving in the city from all parts of the country to inaugurate the commencement of the buildings of the respective States with appropriate ceremonies. The electrical field will be well represented in Electricity Building in the exhibits. The General Electric Company intend to make a most elaborate show. Their space is to occupy at least 1,000 square feet, and possibly half as much more. The design of their exhibit is understood to be original and striking, and likely to create a sensation. They are entering into the work with zeal and liberality, evidently determined to maintain their well known standard. The Westinghouse Electric and Manufacturing Company have also secured one of the large central spaces, which will be filled with an extensive and interesting exhibit. The old rivalry for excellence and novelty of design between the two companies, which now becomes a prominent factor in every exhibition, will be in full force. Another important exhibit will be that of the Brush Electric Company, which has taken a large amount of space and is to be fitly represented. The Fort Wayne Co. will also be in the front rank. An exhibit second to none in general interest will be that of the American Bell Company, which is now actively engaged in the work of preparation in co-operation with the Southern Bell Co. and the Atlanta Exchange. Its display, which will cover over 1,000 feet, will comprise a complete central station, operating telephones in all parts of the grounds, connected with the main system in Atlanta, and with the long distance system throughout the State. Its space is to be handsomely and expensively fitted up, and the growth and progress of the telephone business is to be thoroughly illustrated.

In view of the remarkable impetus recently apparent in the business of the South, this exposition gives an excellent opportunity for the advertising of Northern wares, and that electricians are fully alive to its importance is shown by the fact that many Northern electrical firms have applied for space, and are expending much care and money in preparing their exhibits. Unquestionably one of the most attractive features of the exposition will be the electric fountain in the centre of the great lake. Of course, this has been designed by and will be erected under the supervision of Mr. Luther Stieringer, whose name is now identified with the most successful production of spectacular effects by the play of light on moving water both in this country and in Europe. Mr. Stieringer who was the Consulting Electrical Engineer of the World's Fair, holds a similar commission at the Atlanta Exposition, and the management is understood to have expressed the highest commendation of the results of his designs. Although recent expositions have been indebted for much of their popularity to the beauty of their electric fountains, the coming display promises to far surpass in brilliance and originality anything of the kind yet seen. The water designs are rich in character and bewildering in variety. They consist of wheat sheaves, ring curtains, rings of geysers, oscillators, lily jets, large and small parabolas, a mist bank, and a mammoth geyser. The mist bank is an entirely new idea in hydraulic effects. It will envelop the fountain area in a dense mist of spray, and will be illumined with colored lights in endless combinations. Twenty-three powerful electric projectors will be used, each of which will be not less than 250,000 candle-power. To attain the countless hydraulic effects of which the fountain is capable a perfect network of pipes will be needed. The water will be furnished to the fountain at 100 pounds pressure through a sixteen inch main having a capacity of 15,000 gallons a minute, by the pumps of the Worthington Pump Company, of New York, whose comprehensive exhibit in the machinery hall will be one of the most interesting displays of the exposition. Rising from the surface of the lake, the fountain structure containing the operating chamber will present the appearance of a half-submerged rocky island of irregular form, some 100 feet long and 50 feet wide. It is to possess a distinctive feature never presented at any of the great expositions. When in position, the fountain will be plainly visible from base to apex from almost every point on the exposition grounds, and the mirror effect produced by the reflection of the play and flash of color and light upon the waters of the lake will be unique. The highest jets will rise over one hundred feet from the basin of the lake and will be tipped with light.

The Western Electric Co. is reported to have some original plans for its exhibit. This will be readily believed by those who saw its wonderfully clever and successful exhibit at the World's Fair. An Electric Scenic Theatre is promised by one of the exhibitors whose name is not yet disclosed.

ELECTRICITY BUILDING AT THE ATLANTA EXPOSITION.

VETO OF ELECTRIC LIGHTING LEGISLATION IN PENNSYLVANIA.

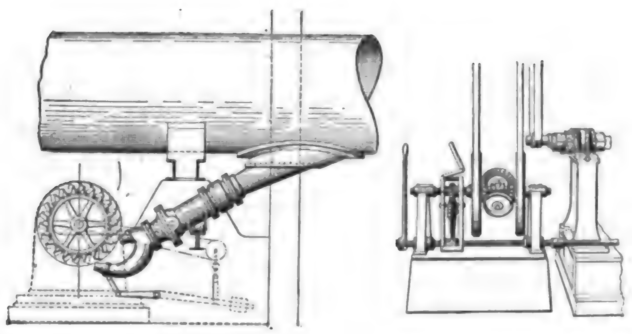
Gov. Hastings of Pennsylvania has vetoed the twin electric light bills, which provide that, in addition to boroughs, all cities of the first, second, and third classes shall have the right to manufacture electricity for municipal, borough, or commercial purposes. The veto was in accord with strong petitions which have been sent to the Governor from all parts of the state, and the ground for the veto is that the bills require boroughs and cities to condemn existing electric-light plants and pay for them as conditions precedent to furnishing light on the part of the municipality for its own use and the use of its inhabitants. "No matter how antiquated, useless, or undesirable the works of such corporation may be to the municipality, it is required by this bill to make the purchase before it can exercise the power to light its own streets and furnish light to its citizens." Gov. Hastings says: "I am of opinion that the furnishing of light, at least for municipal purposes, is a proper function of the municipality as such, and that it should in no wise be abridged by legislation."

LONG DISTANCE TRANSMISSION AT 10,000 VOLTS.

(The Pomona Plant.)[1]—I.

BY GEORGE HERBERT WINSLOW.

The Pomona plant was installed in the summer and fall of 1892 for the San Antonio Light and Power Company, of Pomona, Cal. It was increased in the following spring, and early last year the capacity of the plant was doubled by duplicating the entire equipment. At the present time, when the plant has been in regular operation for more than two years, and its complete success has established confidence in the successful outcome of many similar projects of greater magnitude, it seems fitting to present a careful description of the entire installation. The electric plant was installed under the personal direction of the writer,



Figs. 1 and 2.

as electrical engineer, who presents many of his personal observations on its construction and operation.

The plant is used to transmit energy from a waterfall to substations at Pomona, 13¾ miles distant, and San Bernardino, 28¾ miles distant, from which points it is distributed for incandescent and arc lighting. It consists of a Pelton water power plant and a Westinghouse alternating current transmission plant in which generators supply currents to sets of raising and lowering transformers operating at 10,000 volts, and delivering current to the local circuits at 1,000 volts.

The water power for this plant is derived from the San Antonio creek, which is chiefly supplied by the melting snows and the rains on San Antonio Mountain. Side cañons, however, also furnish some water.

At the lower end of the valley a sharp ridge extends eastward from the side of a neighboring mountain, from which it originally split off, and blocks up the valley except at a narrow place at which bed-rock is exposed and through which the stream plunges suddenly downward at least 90 feet between precipitous walls of rock, forming the San Antonio Falls. To utilize this fall, part of the water is diverted by a dam about 200 feet above the falls into a canal which conducts the water to a tunnel passing through the ridge. At the other end of this tunnel the water enters a large pipe leading to the power-house, which is located 412 feet below the level of the outlet of the tunnel.

The pipe is of sheet steel, double-riveted throughout, and was delivered on the ground in sections having a length of 11 feet 6 inches. These sections consist of four sheets each three feet long. The diameter of the pipe up to within 450 feet of the power-house is 30", with the exception of the length which connects it to the sand-box at the top of the pipe, which length is considerably expanded, so as to allow the water to flow slower on entering, and thus to reduce the entrainment of air. Near the power-house a "reducer" is inserted in the pipe to reduce the diameter to 24", and this size is maintained from this point to the power-house. The pipe was designed to carry 2,000 miner's inches of water (measured under a head of 6 inches), without unnecessary loss by friction. The capacity is equivalent to 50 cubic feet per second, or 1,882 H. P. at 390 feet effective head, assuming a wheel-efficiency of 85 per cent. This is nearly three times the power for which the present station was built, but the extra capacity of 1,000 horse-power obtained by increasing the capacity of the pipe costs so little when compared with the cost of building an entire new pipe-line, that it is much more profitable to lay the larger pipe in the first place, if sufficient water can ultimately be developed to utilize the added capacity.

The thickness of the pipe is increased as it nears the power-house to provide for the increase in pressure in the lower parts. At the first bend it is made greater than that of the sections above it on either side, because the pressure on it is greater. After passing the second air-valve, first No. 10 and then No. 8 steel is used, the latter size being continued to within a short distance of the power-house. The last few lengths are of No. 6 steel.

The horizontal distance between the mouth of the tunnel and the power-house is 1940 feet, and the difference in level between the tunnel and the floor of the power-house is 412 feet. The total length of the pipe, following the line, is 2,370 feet.

The sections of pipe as received from the makers were coated with asphalt both inside and out, and parts of this coat were of course scraped off through rough handling. After the pipe was laid and jointed, a man went through it and painted the joints with hot asphalt to prevent rusting.

In order to protect the pipe from the great changes in temperature which occur in the mountains between midday and midnight, earth and loose rock were placed around and on top of the pipe without any tamping, and where enough earth could not be conveniently obtained, brush was cut and piled on the pipe and covered with a light layer of earth and rock.

The lower end of the pipe is closed by means of a 24 in. Ludlow gate-valve, which is bolted to a cast-iron flange riveted to the end of the pipe.

The stem of the valve is geared to a small hand-wheel, partly on account of its weight, but chiefly in order that the gate may not be shut too quickly, as otherwise the pipe would be subjected to severe strains, resulting from suddenly checking the velocity of the column of water. The gate is connected by a tapering pipe of steel to a horizontal, cylindrical steel receiver 20 feet long and 42" inside diameter, from which the water is distributed to the wheels.

Two tapering cast-iron pipes (a large and small one) are bolted to the lower side of the receiver at an angle of 30 degrees. These pipes conduct the water from the receiver to the under sides of two independent Pelton water wheels, which drive an alternating current generator and its exciter. (See Fig. 1.)

The pipe running to the generator wheel is provided below its valve with two nozzles cast in one piece and attached to the valve by means of a limited ball-and-socket joint, which permits them to be moved vertically to deflect the water.

A set of tips of different diameters is supplied with each nozzle, so that the size of the jet used may correspond to the maximum load and thus unnecessary waste of water be avoided. The tips for the generator-wheel range from 1½ to 2½ inches in diameter, while those for the exciter are from $\frac{7}{16}$ to ¾ inch. When tips are used of the proper size for the full load there is no need of throttling at the full load, and, therefore, no loss from this cause; and with the deflecting nozzle there is no waste of water at full load, so that for full load the two arrangements are equally good. This is not, however, the normal condition of operation of a lighting plant, for in such a plant each dynamo is driven by a separate wheel, and the load is constantly changing, so that here the deflecting nozzle has the advantage. The deflecting nozzle is also to be preferred under high heads, to avoid the risk of straining the pipe by suddenly checking the flow of water, as would be necessary with a throttle valve if the entire load were suddenly thrown off.

The speed of the generating-wheel is maintained constant for different loads by deflecting the stream. This is done by raising or lowering the deflecting nozzle from the dynamo-room by means of a lever fixed to a shaft which passes through the wall and carries a short lever connected to the nozzle by a link. The weight of the nozzles is counter-balanced by a movable weight on a horizontal lever-arm fixed to the shaft. The change of position of the nozzle is made automatically by the use of the Pelton differential governor. The arrangement for governing is briefly as follows: The generator is geared to stop itself by turning the water off the wheel, and

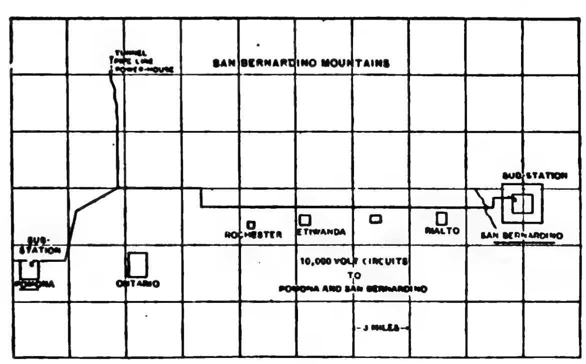


Fig. 3.

the source of constant speed is geared to speed up the generator by a contrary action. These two actions neutralize each other when the generator-speed is the same as the fixed speed, but when either preponderates the difference acts. Thus an increase in generator speed will act to stop the generator, while a decrease, by making the fixed speed predominant, acts to speed up the generator. The governor consists, in part, of two similar miter-wheels which are mounted upon pulleys and placed face to face, loosely, upon a horizontal shaft, and are driven at equal speeds in opposite directions, one by the generator shaft, and the other by the exciter shaft. The speed of the pulleys is 200 R. P. M. In Fig. 2 it will

1. Abstract of a paper read before the Amer. Inst. of Elec. Engrs., Niagara Falls, June 26-30, 1895.

be seen that between these wheels, and at right angles to the supporting shaft, there is fixed to the latter a cross-bar, carrying two miter-wheels, one at each end, which mesh with the two oppositely revolving miter-wheels first mentioned. The result is, as long as the two outside wheels are revolving at the same speed the two central wheels will merely revolve upon their axis without tending to move in either direction the arms upon which they rotate. Now, if the generator-speed increases, the corresponding side of each central wheel will have to travel faster forward than the other side travels backward, and the difference between these two movements will result in a movement of the central wheels in the direction of a faster wheel, and the cross-bar will consequently move the same way. The shaft to which the cross-bar is attached will, of course, turn with it, and as this carries a pinion meshing in a toothed quadrant connected to the lever which controls the nozzles, the stream will be pulled away from the wheel until the generator speed falls to its normal value.

In order to avoid see-sawing it is the practice in this plant to reduce the head every morning during the light load. This is readily done by opening the extra 4" relief-valve and allowing water to escape until the pressure has gone down to that corresponding to the desired head. The valve is then set tentatively until the pressure remains about constant, when the final adjustment is made by partly closing the valve on the generator-wheel pipe. Meanwhile the governor throws more and more of the stream onto the wheel to compensate for the decrease in head, and the see-sawing stops.

To start the plant, the governor ratchets are first disengaged and the exciter is brought to a moderate speed; the generator is then started and its field is charged; it is then brought to about three-fourths of its full speed, and the speed of the exciter is then slowly increased until the cross-bar on the governor ceases to move. At this moment the ratchets are thrown in, and the governor takes charge of the generator speed. The speed of the exciter is now slowly increased to its full value, which of course brings the generator to full speed. The speed of the exciter-wheel is regulated by a small throttle-valve, the changes in the position of which do not have any noticeable effect on the pressure in the pipe, owing to the small size of the jet controlled.

The power house is 66 ft. long by 30 ft. wide, and has walls 12½ ft. high. The walls, which are of concrete, were all built by tamping concrete in a space between temporary wooden walls forming a mould, a few feet of wall being built at a time, and the planks then loosened and raised to the height of the next section, the walls being thus made at the least expense for timber.

The station was built to accommodate four 120 K. W. 7,200 alternation, 12-pole, single-phase Westinghouse alternators, with

GENERATING STATION, SAN ANTONIO LIGHT AND POWER CO.

their full complements of raising-transformers and switchboard apparatus, and two exciters. The first installation consisted of one generator with one 90 ampere 125 volt "I" exciter, capable of exciting the four alternators, and of 126 K. W. capacity of oil transformers in 21 units of 6 K. W., one of those units being kept as a reserve.

Several different methods of connecting the raising and lowering transformers were given careful consideration, the test of actual use favoring a series connection for both primary and secondary coils of both sets of transformers, a plan which has proved to be thoroughly reliable in its practical operation at the Westinghouse plant at Portland, Oregon. It was however decided, in order to be able to change the initial pressure on the line in case of accident to any of the converters, to connect the primary coils of the raising transformers in multiple to the dynamo, put the line coils all in series with the line and with a similar set of coils in the lowering transformers, and connect the other coils of the latter in multiple to the distributing circuits.

The next question was what size of transformers should be used. Many small transformers meant less cost per unit for repairs, greater facility of handling, and greater flexibility in case it were desired to change the voltage on the line. Their use, however, also meant greater first cost, more complication, and somewhat lower efficiency, but these points were outweighed by the former, and a transformer unit of 6 K. W. was chosen. Each transformer is contained in a cast-iron box provided with vertical outside ribs, which serve to stiffen it, and also to cool the

POLE LINE THROUGH SAN ANTONIO CANYON, POMONA POWER TRANSMISSION.

oil with which the box is filled, and which entirely covers the transformer. The box is covered by a cast-iron lid, which has conducting and radiating ribs both outside and in, the inner ones dipping into the oil at its hottest part and helping to cool it.

It also has an oil-gauge to show whether the tops of the coils are completely covered without having to raise the lid. The boxes are supported upon a substantial timber frame, upon the top of which two iron bands serve incidentally to protect the wood, but chiefly to metallically connect the boxes to each other and to the earth, in order to dissipate the static charge received by the boxes, which is very unpleasant. The core of the transformer is connected to the box by a copper strip fastened around a block of wood upon which the core rests in the box, and to provide against the danger which would result from accidental connection between the primary and secondary coils, an insulated sheet of copper is placed between the latter and close to the dynamo-coil, and is connected to the core by a tongue which is stuck between the plates.

The line-coil of No. 7 B. & S. gauge wire, is inside the dynamo coil, and is kept everywhere at a distance of one-half inch from the latter, the ground plate, and the core, by walnut blocks boiled in paraffin, between which ample openings are left for circulation of the oil. The ratio of transformation is 1000 to 450, so that in a bank of twenty transformers the dynamo pressure required for 10,000 volts on open circuit is 1,110 volts, and on full load about 3 per cent. more than this, or 1140 volts. The space between the 1,000 volt coil, and the core, is one-eighth of an inch. The terminals of the line-coils are brought up through the oil in mica-fibre tubes passing through heavy glass bushings held in paraffined wooden blocks which are attached to the sides of the boxes. The 1,000 volt terminals are similarly supported, but without glass bushings. The transformers are all connected in multiple to the dynamo-circuit, which is supported directly above them on a light pine framework, which also supports the fuse-blocks. The latter are single-pole, and the fuse passes through a hole in a marble block, the object of so confining the arc being to blow it out by its own force. Only one fuse is used on each transformer. The secondary or line coils are all connected in series by U-shaped insulated wire connections which may be readily detached when making periodical tests for insulation of terminals, and which are entirely independent of the frame-work supporting the dynamo circuit. Accidental contact with the exposed connectors is prevented by the framework above mentioned, and there is an inflexible rule that the high tension side of the transformers shall not be touched under any circumstances whatever, while the dynamo is running.

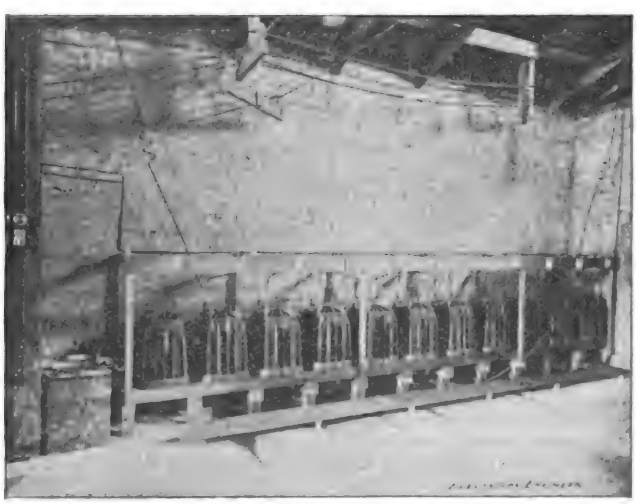
Clark's insulation is used on all wires connected to the trans-

formers and to the dynamo, and the terminal wires of the full bank, which must often be disconnected for testing, are further insulated by heavy glass tubes at points where they might come in contact with other wires. All other transformer wires are supported upon double petticoat glass insulators, and all dynamo-wires upon porcelain knobs.

The switchboard is of narrow red-wood boards, tongued, grooved and beaded, nailed on a framework of yellow pine, the latter supported on porcelain insulators to keep it dry. The switchboard outfit for the one generator and one exciter consists of two 120 amp. fuse blocks, field rheostat with a 25 amp. D. P. field switch with fuses, one 150 amp. ammeter and a 200 amp. D.

OUTLET OF TUNNEL, PIPE LINE IN CENTRE OF PICTURE.

P. jaw-switch. From this switch the current passes to two 4-dynamo, marble switch-panels which are connected in multiple to the dynamo, and are each provided with two pairs of contact plugs. By means of these panels and of the two 200 amp. dynamo-changing switches below them, any feeder can be operated from any dynamo which is connected to the switch-panels. Between each panel and its switch is a pair of 65 ampere Wurts shunt-wire fuse-blocks, each provided with an extra fuse and shunt which can be connected by inserting a plug should it be desired to double the fuses during the run, on account of overload or of weakness in the fuse. The remaining instruments on each feeder are a voltmeter, a No. 1 switch-board converter and a 150 amp. type "E" compensator. When both feeders were run from one alternator, one voltmeter was connected to the genera-



BANK OF 10,000 VOLT TRANSFORMERS.

tor and the other to the feeder, and in this way the amount of compensation could be watched.

The oil-transformers were tested before shipment with 20,000 volts between the line-coil and the core and were then taken out of the oil and boxed. In order to expel any moisture which might have been absorbed by the insulation of the coils or have condensed on the cores during their long journey, the transformers were connected in two banks of ten each, the line-coils of each set being connected in series to the generator, which was run at a reduced speed, and the secondary coils each short-circuited on itself. The coils were thus gradually heated to a point somewhat above the boiling point of water, which at that elevation was about 201 deg. F. They were kept at this temperature for a short time and then paraffine oil of a special grade ("Diamond") was poured slowly into the boxes at the edges so that the coils would begin to absorb oil at their lower ends, and thus drive upward the air and volatile gases occluded by the insulation. The transformers were then again brought to their former temperature, which caused expansion and partial expulsion of the air remaining in the insulation. Some of the air would however collect under the insulation at the top of the coils, and had to be freed by mechanical agitation, produced by stirring the folds of insulation or by pounding on the boxes. The heat caused volatilization of some of the lighter elements of the oil, these coming to the surface as bubbles, just as the air did at first, and the agitation was kept up at intervals until bubbles from this cause also were entirely eliminated.

The 20 transformers were then connected as they would be when in regular use, and the two terminals of the line-coils, which were to give 10,000 volts, were connected in series with one hundred 100-volt lamps, which were then brought to full candle power, showing that the transformers were all in good condition. A similar test was then made at Pomona at the end of the 14-mile transmission line running to that place, after which the transformers there were prepared for work in the same way as at the power-house, except that the grouping and initial voltage were changed.

THE GUTTA PERCHA SUPPLY.

Mons. Hourant is making a determined and commendable attempt to put an end to the outrageous destruction of gutta percha trees which has so long been allowed to continue. He proposes to export the leaves of the tree and subject them to a special process which gives an excellent quality of pure gutta percha. The *Sarawak Gazette* says on this subject: "After some difficulty in getting natives to work systematically at the collection of the leaves, which had hitherto been looked upon by them as possessing no value, Mons. Hourant is now exporting leaves in quantities which increase month by month, and has erected a factory in Kuching for the purpose of thoroughly drying them before shipment. The advantages of this method of obtaining such a valuable product as gutta percha are evident. The native plan of cutting down a tree to obtain the sap was wasteful in the extreme. It has been estimated by carefully experimenting that an adult tree of 25 to 30 years of age yields of *pure dry* gutta only one catty; as much can be obtained from two pluckings of the leaves of a tree, without injuring it, and it will long continue to put out fresh foliage, and, what is more important still, will live to seed and reproduce its species; and the better kinds of gutta tree do not fruit until 30 years of age. The average gutta tree of 60 centimetres circumference at 5 to 6 feet from the ground was found to yield, by the native process, only ⅞ths catty of pure dry gutta. This is not so good as the 7 to 10 per cent. by weight obtained from the dried leaves; also, the gutta obtained from the leaves is chemically pure and dry, which is more than can be said of much of the Dyak gutta found in the bazaars. The millions of trees already destroyed by the native gutta hunters are still of service to Mons. Hourant, as their stumps have sprouted out into numerous small shoots, much in the same way as an osier does, and though these stems are too small to produce gutta, their leaves are as good as those of an adult tree."

FRENCH ELECTRICAL COMPETITION FOR PRIZES.

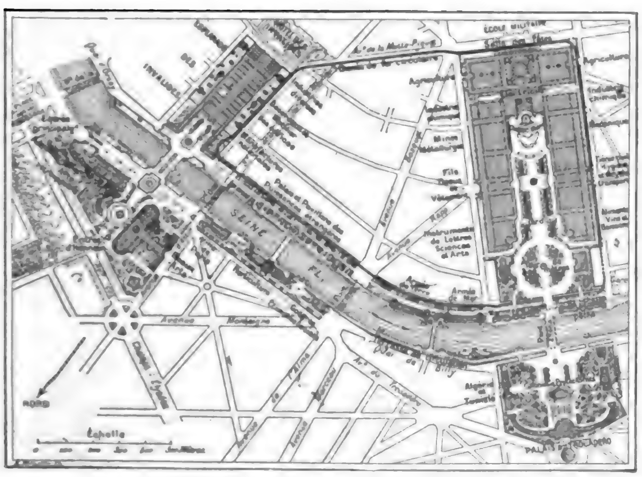
The Société d'Encouragement pour l'Industrie Nationale, Paris, offers some special prizes in the electrical industry and others. A premium of 2,000 francs will be awarded in 1896 for a small domestic motor, working independently or connected with a central station, and having an output of from 6 to 20 kilogramme-metres per second. This prize has already been awarded four times; on the first occasion to a hydraulic motor, on the second to a steam-engine, on the third to a gas-engine, and on the fourth occasion to a system of house-to-house transmission of power. It is now desired to vary the form and system of the motors, so that it would seem that the society is anxious to see what electricity can do in connection with its offer. A premium of 1,000 francs will be awarded in 1896, if it be earned, for a new alloy useful to the arts. The society is induced to hold out this prize for competition in view of the great results which have been achieved with aluminum, and of the possibilities that one or more of the newer metals may present means of forming a useful and successful alloy. A premium of 2,000 francs will be given in 1896 for an electric incandescent lamp using 0.05 ampere at 100 volts. The object is to obtain a lamp of small illuminating power running at a high voltage. The last prize is one of 3,000 francs, which is offered for bestowal in 1897, for a treatise embodying important improvements on the present methods of producing permanent magnets. Competitors should forward their schemes, models, etc., to the Secrétariat de la Société d'Encouragement pour l'Industrie Nationale, rue de Rennes, 44, Paris, before December 31 of the year preceding the distribution of the premiums.

THE PARIS EXHIBITION OF 1900.

Some idea of the magnitude of the exhibition that is to be held in Paris in 1900, may be gathered from the full report just issued by the general commissioner, M. Alfred Picard, who has been engaged for some time past in sifting the numerous proposals that have come from all parts of the world. Not a few of these projects are very ingenious. But it must be confessed, that by far the greater number are either impracticable or absurd. Nevertheless, they afford plenty of ideas that may be developed, and put into shape later on. And they promise to make the *fin de siècle* exhibition, worthy of the century's progress in art, science, and industry that it is intended to illustrate.

For the moment the Commission is chiefly concerned in deciding upon the main lines of the exhibition; the laying out of the grounds; the arrangement of the buildings, and the principal features that are to give the key-note to the whole enterprise. To secure the best possible results the Commission has incorporated many of the most promising features of the 108 plans that were submitted to them.

The site upon which the exhibition will be laid out has an area of about 320 acres. It includes the whole of the Champ de Mars, the banks of the Seine, and the space lying between the Champs-Elysées and the river. The whole of this vast area is to be cleared of the existing edifices with the exception of the Tour Eiffel, the Trocadero, and the Machinery Hall, which last building will, however, only occupy a secondary place in the general arrangement. It was at first proposed to do away with everything belonging to the last exhibition of 1889, but it was at last decided to leave the three principal edifices standing, the more so as the pulling down of the Tour Eiffel would involve considerable expense, while an enormous indemnity would have to be paid to the company owning it. None of the proposals for altering the aspect of the tower are satisfactory, and it is thought advisable to let it remain as it is.



PLAN OF THE GROUNDS AND BUILDINGS, PARIS EXHIBITION OF 1900.

An important landmark will, however, disappear in the Palais de l'Industrie which will have to come down to allow of the carrying out of one of the most interesting schemes of the exhibition. The principal entrance will be at the Place de la Concorde, that is to say, almost in the very centre of Paris. This will have an imposing facade, and will be in harmony with the general scheme of the exhibition. Once inside the exhibition the visitor will find himself in a long avenue, sheltered by trees, on the left of which, will be the Seine, and on the right two groups of buildings; one, devoted to the administration, to a retrospective exhibition of the arts, and to instruction, and another, to the Beaux Arts, upon which all that is best in French architecture will be lavished.

Between these two groups, and cutting the avenue in two, will be a wide and spacious boulevard, running from the Palais de l'Elysée to the Mansart cupola. It will cross the Seine by means of a bridge which will be one of the most striking features of the exhibition. Designed upon very picturesque lines, with a single span, it will be constructed entirely of steel, and will have a width of 60 meters, the same as the boulevard, and it will be laid out with gardens and terraces. The perspective formed by this boulevard with the Palais de l'Elysée at one end, and Mansart cupola at the other, will be one of the finest in Europe.

Between the Pont des Invalides and the Pont de l'Alma palaces will be erected on each side of the river, one group for the foreign Powers, and the other for the city of Paris, an exhibition of horticulture, and social economy. Terraces will also be laid out along the Seine with gardens and statuary, and the effect of these long lines of rich and picturesque buildings will be remarkable. It is intended to make great use of the Seine for decorative purposes, and at night Venetian fêtes will be held, when the gondolas and the illuminations of the palaces reflected in the water will give one the impression of the Grand Canal of Venice.

The Champ de Mars will be given up to manufactures and industries. It is here that will be found the great attraction of the exhibition. Upon the site of the plaster statue of the Republic, just in front of the machine gallery, will be erected a magnificent Palace of Electricity which will dominate the whole grounds. The exhibition is to be an apotheosis of electricity that will mark the beginning of the new century. No other power but electricity will be used in the grounds. Before this palace will be a fountain, and then a series of gardens will be stretched away to the Tour Eiffel. Upon either side will be the different annexes devoted to agriculture, mining, metallurgy, industrial chemistry, textile products, scientific instruments, alimentary products, etc.

These different sections will be laid out in straight lines with plenty of space between them, and the exhibits will be so arranged that visitors will be able to see the whole process of manufacture at a glance in each group. A sort of elevated railway will pass through every building and communicate with each section to permit of visitors seeing the whole of this part of the exhibition without trouble. The Trocadero will continue, of course, to play an important part, since for decorative and illuminating purposes it is unrivalled. In the area covered by these grounds will be seen the products of the French colonies, and a special annex will be reserved for Algeria and Tunis. So much for the general lines upon which the Exhibition will be laid out.

As for the special features, about fifty proposals have been selected for further consideration, out of the mass of schemes submitted to the Commission, and, by a shifting process, they will no doubt be eventually reduced to something like half a dozen. M. Francois Deloncle, the well-known deputy, is anxious to construct a telescope that will bring the moon to within a few miles of the observer; M. Camille Flammarion, the celebrated astronomer, wants to see an enormous sphere representing a satellite around which the public can be taken in balloons; and M. Pascal Grousset, whose thoughts turn in a different direction, points to the scientific advantages that might attend the exploring of the centre of the earth, or at least as near the centre by a few thousand miles as it is possible to get, by driving a hole, down which visitors of a curious turn of mind could be taken. This scheme has already been described in THE ELECTRICAL ENGINEER. Whatever may be the proposals selected they are certain to be of a very novel character, as the Commission is anxious above all to strike a note of originality. In such a vast exhibition special attention is naturally being given to the question of transportation, and this will be provided mainly by an electric railway which will run all round the grounds, while some of the railway companies will run trains right into the exhibition. It is to be feared, however, that the transportation facilities both in and out of the exhibition will fall very short of the needs of the enormous influx of visitors.

The estimated cost of the exhibition is \$20,000,000, of which \$14,600,000 will be spent upon the buildings. It is proposed that \$4,000,000 shall be paid each by the State and the Municipal Council of Paris, and that the rest shall be raised by the issue of sets of twenty tickets, that shall not only allow of admission to the exhibition but shall give advantages in the way of reduced fares over the railroads and admission at a cheap rate into the places of amusement.

MR. W. H. PREECE AND HIS TIRELESS SLAVE.

The *New York Times* in a recent very interesting column on electrical advances, has the following neat little item of gossip:

What between electric cooling fans and electric heating devices, we shall soon be able to take any kind of weather provided by the Meteorological Department, either in summer or winter with perfect equanimity. W. H. Preece, the well-known English telegraph chief, dwelt, in a recent address, on the extent to which the creature comforts of this generation are being increased by electric heating. During the last winter he had his office kept constantly at 60° Fahrenheit, a temperature which the Englishman considers ideal in cold weather, and all through the exceptionally severe winter his office was always comfortable, and its air was always fresh and wholesome, thanks to his electric radiator. Mr. Preece gave a humorous account of some of his experiences in domestic electric heating and cooking. In his own house he has an electric oven, and the dishes cooked in it are a perpetual pleasure. On his breakfast table is an electric warmer that keeps the breakfast dishes hot. Curiously enough, he had the warmer fixed almost solely to accommodate his boys, who would invariably lie in bed in the morning, and always come down to a cold breakfast. After vainly trying for years to break them of this bad habit, he got the electric hot dish, so that at all events the meal might be kept warm. The hot plate kept the dishes in perfect order, but as showing the contrariness of the boyish race, the moment the boys lost the charm of the cold dishes, they came down punctually to breakfast, and, in fact, since that time he has been the last and they have been the first.

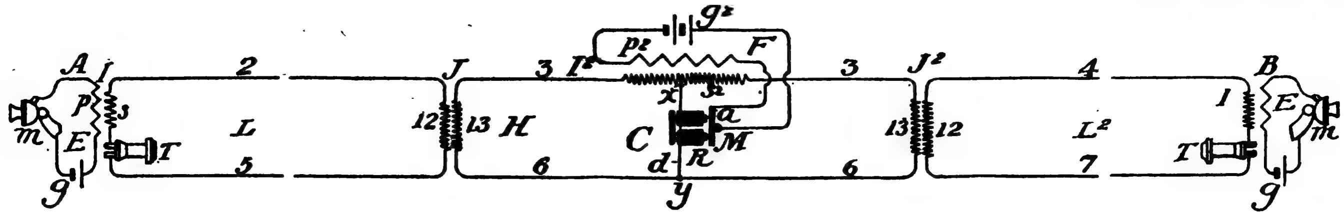


Fig. 1.—The Arnold Telephone Relay System.

THE ARNOLD TELEPHONE RELAY.

Notwithstanding the ill success of inventors in the past in their efforts to devise a telephone relay, work in this department is by no means being neglected, as evidenced by a number of patents issued last week to Mr. Chester H. Arnold and Mr. W. L. Richards, all of which are assigned to the American Bell Telephone Co.

Among these the patent of Mr. Arnold, No. 554,918, is typical of its class and of a large line of development in the same direction, and we therefore give a description of his relay illustrated diagrammatically in the accompanying engravings.

The essence of the invention consists in associating the relay or repeating apparatus proper, including its local repeating-circuit, with a short but conductively-complete auxiliary section of the main line, and in combining the section and its associated repeater mechanism and arrangement with the two main telephone circuits which are desired to repeat into each other, in such a way that it is inductively connected with both by means of repeating induction-coils, and thus constitutes a link connection between the two main circuits, uniting them into a single compound circuit for through communication. At the same time the balance is much facilitated by reason of the shortness of the complete middle-line section thus interposed at the central, intermediate or repeating station between the ends of the two circuits concerned.

In Fig. 1, which indicates the simplest exemplification of the invention, A and B, are sub-stations at the outer ends of the telephone circuits L and L^2, and C is an intermediate or repeating station entered by the other end of both circuits.

At the terminal stations A and B is the ordinary sub-station apparatus, consisting of a receiving-telephone T, a variable-resistance transmitter m in the local circuit E of a battery g, and the transmitter induction-coil I, whose primary winding is in the local circuit and whose secondary winding is in the main circuit.

At the central station C is a short closed circuit H, forming the link for through communication interposed between the main circuits L L^2.

Extended between the two conductors 3 and 6 (which are virtually continuations of the conductors 2 and 5 of circuit L on one side and of the conductors 4 and 7 on the other) is the bridge-conductor d, containing the receiving or repeating electromagnet R of usual construction. The armature or diaphragm a of this magnet carries the variable-resistance medium of a repeating transmitter M, and controls the same, the medium being placed in a local repeating-circuit F, including also a reinforcing-generator or battery g^2.

An induction-coil I^2 is interposed between the local circuit F and the central-station section H of the main line, and by its instrumentality the variations of current occurring in the local circuit are impressed in reinforced magnitude upon the main-line section. The long and fine wire secondary winding s^2 of the induction-coil I^2 is placed in the circuit of the main-line section H and is split or divided by the bridge connection at x, so that one-half of the winding is on each side of the bridge connection. The single or undivided coarse and short wire primary winding p^2 is in the local repeating-circuit F.

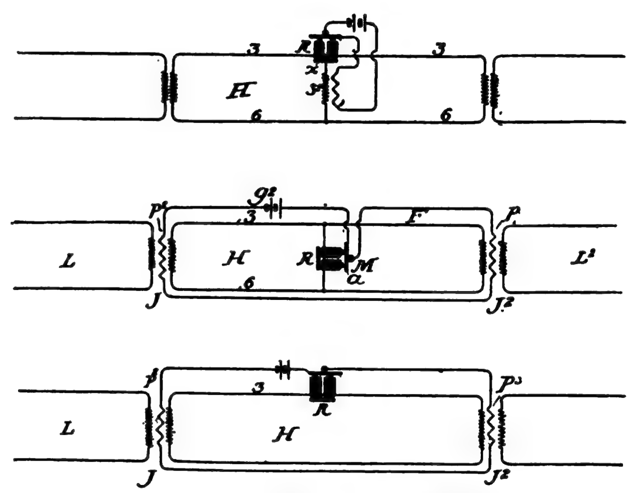
It only remains to describe the means of effecting the connection between the conductively-closed repeating-station section H of the main circuit with the principal or interstation-sections L and L^2. To this end there are interposed repeating induction-coils J and J^2 between the two ends of the station-section H and the central-station ends of the principal sections L and L^2, respectively, one winding l^2 of both coils being in the section H and the remaining winding l^3 of one of the repeating-coils J being in the section L, while the winding l^3 of the other repeating-coil J^2 is connected in the section L^2. The repeating-coils J and J^2 may be constructed on any preferred plan, provided only that the two windings have similar proportions as to length and size of wire, and provided that the windings are so relatively disposed that their mutual induction is at a maximum, so that the currents induced by either in the other is of like potential. This is necessary because transmission is reciprocal and because, therefore, that winding which at one moment is in a circuit which is receiving may at any other moment be in a transmitting-circuit, as the direction of conversation changes.

By the introduction of a short conductively-complete repeating-station section of main line connected with the two principal sections by repeating-coils it becomes possible to equalize the two sides of the electrical balance with great facility and substantial accuracy, first, because they can be made exactly of the same length, and, second, because they are both short.

Fig. 2 shows the same essential elements as are found in Fig. 1. The differentiating feature is the transposition and rearrangement of the repeating-magnet and induction-coil. In Fig. 2 the receiving-magnet is placed in one of the conductors 3 of the office main-line section H, one-half of its winding or one of its spool-helices being placed on either side of the point x of the bridge connection, while the secondary winding s^2 of the induction-coil remains undivided and is connected as a bridge between the conductors 3 and 6 of station main-circuit section H. There is no material change in the mode of operation.

In Fig. 3 the separate repeating induction-coil I^2 is dispensed with, and the local repeating-circuit contains two coarse-wire windings, one associated with the two windings of each of the two main line repeating-coils J and J^2, so that the coarse wire winding p^2 serves as a primary for the coil J, while the winding p^3 serves as a primary helix for the coil J^2. In this way the repeating coils J and J^2 are enabled to replace the repeating induction-coil I^2, so that when the transmission is from L to L^2, J^2 acts as the repeating induction-coil I^2, while when the direction of transmission is reversed the coil J acts as the repeating induction-coil.

In Fig. 4 the special bridge is dispensed with, the repeating magnet R being placed in one of the conductors 3 or 6 of the repeating section of the main-line section, and the division of the local repeating-circuit primary winding into the two sections p^2 and p^3, and their association with the two repeating-coils J and J^2, is relied upon for the establishment of the requisite balance. This arrangement may in some cases be convenient, but is deemed in some respects inferior to those already described.



Figs. 2, 3 and 4.—The Arnold Telephone Relay System.

TELEPHONE NOTES.

Middletown, N. Y.—A call for 25 per cent. of the capital stock of the new Orange County Telephone Company has been made.

Creede, Col.—At a meeting of a majority of the stockholders of the Creede & Bachelor Telephone Company it was definitely decided to build the proposed telephone line to Bachelor.

Philadelphia.—The Delaware and Atlantic Telegraph and Telephone Co. has passed into the entire control of the American Bell, along with the Bell Telephone Co. of Philadelphia, as noted recently. It reaches 150 towns and has about 4,000 subscribers. The Philadelphia company has over 6,000 subscribers.

Detroit, Mich.—The Detroit Harrison telephone company has been organized, the incorporators being O. W. Shipman, Charles P. Collins, R. A. Brett, Albert Pack, Collins B. Hubbard, Frank D. Andrus, William L. Holmes and Charles Flowers. The capital stock is $600,000.

ASHLAND, WIS.—The Wisconsin Telephone Company will soon have a metallic line connecting Ashland, Washburn and Bayfield.

ROCHESTER, N. Y.—The Wayne Telephone and Telegraph Company is being organized with a capital stock of $5,000.

RENVILLE, MINN.—The Renville Telephone Company will construct a loop, and, in addition, will construct a line to Olivia, the new county seat.

DECATUR, ILL.—If the people will put up the money, the Municipal Telephone Line will be extended to Dalton City and intermediate points at once.

HUDSON, N. Y.—The Hudson River Telephone Company has purchased the old Mutual telephone line between this city and Poughkeepsie.

HILLSBORO, ILL.—The Montgomery County Telephone Company has been formed; capital stock, $8,000; incorporators, Chas. A. Ramsey, Jacob J. Frey and William S. Barry.

BALTIMORE, MD.—The name of the Writing Telegraph Company was changed to the Home Telephone and Telegraph Company by an amendment to the charter.

ATHENS, MICH.—The Southern Michigan Telephone Company, which has its headquarters at Athens, now has thirty-five towns connected by wire.

CONWAY, IA.—Articles of incorporation have been filed by the Conway Telephone company with $5,000 stock in 50 shares. The officers are: President, Arthur Haynie; secretary, Miles H. Simmons.

CANTON, ILL.—The Citizens' Telephone Company, of Canton, with double the service now given, has made a proposition to furnish the city with five telephones or gongs, or both, for $100 per year, and all additional instruments at the same rate—$20 per year.

HENDERSON, KY.—The Harrison Telephone Company is in a very prosperous condition. The exchange here will be ready by July 25, and subscribers will be able to use their telephones shortly after that time.

HARRIMAN, TENN.—The Directors of the Mutual Telephone Company have perfected their organization by the election of the following officers: Dr. C. T. Cory, President; J. D. Buck, Vice President; E. C. Drowne, Secretary; W. H. Julian, Treasurer.

MERRILL, WIS.—The Merrill Telephone Company has filed articles of incorporation with the secretary of state; capital $100,000; incorporators, H. H. Foster, H. R. Freeland, C. A. Norway, Julius Thielman and W. H. Flett.

ALAMEDA, CAL.—A new telephone company, entitled the Commercial Telephone Company, has been incorporated to do business in the county of Alameda. The directors are E. R. Smith, Albert L. Stetson, J. D. Johnson, John W. Butler and S. P. Lunt. The capital stock is $100,000, divided into 1,000 shares of $100 each.

HAMILTON, O.—The stockholders in the Bethany and Hughes Telephone Company have held a meeting for the transaction of business. Steps were also taken towards having the company incorporated under the name of the Hamilton-Hughes-Monroe Telephone Company, with a capital stock of $5,000.

WILMINGTON, N. C.—The Inter-State Telephone and Telegraph Company, of Durham, N. C., has asked for a franchise. The building of the system will result in an outlay of about $10,000 in and around Wilmington, and from $75,000 to $100,000 will be expended in the State.

JERSEY CITY, N. J.—Agents who claim to represent a new telephone company that will compete with the New York and New Jersey Company—are canvassing the city for subscribers. They offer to give service on the unlimited line for $48, but to secure this low tariff, subscribers must sign a contract for three years.

CARTHAGE, MO.—The Carthage Electric Telephone Co. is incorporated with T. J. Clark, president; E. R. Wheeler, vice-president and treasurer, and George E. Wheeler, secretary and general manager. This company has purchased the franchise of the American Telephone Co. in Webb City, Carterville and Carthage.

LANSING, MICH.—An order for 400 instruments and necessary equipments for the new telephone company has been placed with the Western Telephone Construction Company. The cedar posts have been ordered and it is expected that work will be commenced on construction this week. The manager expects to have the line in working order by the 1st of August.

CREEDE, COL.—At a regular meeting of the City Council an exclusive franchise was granted the Creede and Bachelor Telephone company. The action of the Creede council will precipitate a fight between the Creede-Bachelor company and W. C. Munsell, who was granted an exclusive franchise for five years by the town of Bachelor, and neither can enter the other's town unless they consolidate.

TRINIDAD, COL.—The City Council has granted a franchise to a company composed of business men of the city to establish and maintain a telephone system in Trinidad.

DETROIT, MICH.—Two 30-year telephone franchises have passed the council; one to the Harrison, the other to the Brown Loud Speaking Telephone Companies.

ELWOOD, IND.—The Pana Telephone Company has sold out to the Elwood Telephone Company, and all litigation between them has ended.

HONESDALE, PA.—The Citizens Telephone Company are pushing along the work of putting up poles and stringing wire. The wire is already up between Carbondale and Honesdale.

SPRINGFIELD, MO.—The Dunlap Construction Company has completed the line of the Christian County telephone company. This line connects Springfield with Ozark, Linden, Sparta and Chadwick.

SACRAMENTO, CAL.—The Board of Supervisors has granted a franchise to the Capitol Telephone and Telegraph Company to place its wires throughout the county. The company will introduce a new telephone service in this city early in July.

HARRIMAN, TENN.—The stockholders of the Harriman Mutual Telephone Company have adopted the Strowger system with automatic switchboard, and perfected plans for the erection of the line.

LENOX, IA.—A telephone company operating at Lenox and Clearfield has petitioned the city council for the right of way into Creston, to put up poles and wires. The council gave them the privilege.

CHESTER, ILL.—The Chester Mutual Telephone Exchange has been formed, without capital, to operate a telephone exchange on mutual plan; incorporators, George I. Ray, V. Steber, William R. Mackenzie.

GRAND RAPIDS, MICH.—President Fisher and Manager Ware have now raised $60,000 of the $80,000 capital stock wanted for the Citizens' Telephone Company and are hustling for the rest.

MONTPELIER, IND.—The Montpelier telephone company has been incorporated with a capital stock of $20,000. The shareholders are John Burns, W. N. Pay and Jerry Hayes, all of Montpelier.

DETROIT, MICH.—The Common Council has passed the Harrison Telephone Company and the Brown-Loud Speaking Company's telephone ordinances, amended so that the companies shall be compelled to place their wires underground within the half mile circle for the present.

ALTOONA, PA.—The success of the new telephone company is practically assured. It is said that Councils will grant the franchise permitting them to string wires over the city, and the charges will be $2.00 per month for a business house and $1.50 for private residence per month.

MASON CITY, IA.—The new city telephone system is to be put in by the Phoenix National Telephone Company of Indianapolis, Ind. The rentals are made very low, $2 a month for business houses, $1.50 for residences, and $3 where both are taken by the same subscriber.

NIAGARA FALLS, N. Y.—A number of local business men have interested themselves in the new automatic telephone, which is being shown at present at room No. 6 in the Arcade, and the outcome is that a local telephone company is about to be organized. The company will be known as a branch of the Mutual Automatic Telephone Company.

TOLEDO, O.—The Central telephone conduit ordinance has been adopted by the board of aldermen. Work will be begun on the conduits just as soon as the ordinance is signed by the mayor. It will be one of the most complete systems of underground wires in the world. One of the finest switchboards made will be used in the exchange. This will cost $100,000.

WILMINGTON, N. C.—The North Carolina State Telephone Company has been organized with L. H. Carr of Durham as president. Three thousand miles of wire have been ordered, and Wilmington, Winston, Raleigh, Goldsboro, Durham, Greensboro, and Charlotte will be connected. It is intended eventually to include all the principal towns in North Carolina and South Carolina in this long distance system.

NILES, MICH.—The city council has given the Bell Telephone Co. a respite, in order that they may consent within that time to annul their contracts with various companies who were compelled to drop the Gilliland phones. The general manager of the Bell company, F. A. Forbes, and an attorney from Detroit, H. E. Boynton, have visited Niles, and announce their intention of giving the city a warm legal fight if the latter attempts to remove their property.

ELECTRIC TRANSPORTATION DEPARTMENT.

BOSTON ELECTRIC MAIL CARS.

BY W. S. KEY.

The various branches and ramifications of the West End R. R. system, which reach not only any part of Boston proper but extend out, like a spider's web, to almost any point in the extensive suburban district, presented an admirable opportunity for abbreviating the time hitherto occupied in distributing the mails between the chief post office and the sub-offices on the outskirts. Realizing this fact, negotiations were opened between the Mail

THE BOSTON ELECTRIC MAIL CARS.

Department and the Directors of the West End R. R., which resulted in a contract being placed for the building, equipping and operation of a certain number of cars. Thereupon the West End Co. proceeded to change or reconstruct eight ordinary 16-foot box cars, and to adapt them in every way to the service for which they were intended. The interior was fitted with a number of pigeon holes as in the mail cars on the steam roads, and sorting counters are placed along the sides of the car in front of the pigeon holes. There is also an iron frame on which to suspend

INTERIOR, U. S. TROLLEY MAIL CARS, BOSTON.

the mail sacks with open neck so as to receive the matter belonging to them. Overhead is a roomy rack into which are thrown the empty sacks after the mail has been removed from them. To all intents and purposes the cars are a diminutive duplication of the regular railway mail car.

In reconstructing these cars a door was built on each side, the rest being boxed in; no other change being necessary. They are painted white picked out in gold, the lettering being done in red and gold, which makes the cars look very conspicuous and attractive on the street.

The dashers are made solid on opposite sides, the off side being closed by a Wood patent gate. The end doors are permanently closed, admission to the inside being alone gained by the side doors. Each car is equipped with two General Electric motors of 25 H. P. capacity each, the controllers being of same make.

These cars are run on a one hour schedule to and from five different localities, collecting and distributing mail sacks en route. One car runs on a cross town route, between suburban offices, and one car is kept for night service. It is expected that ere long some of the larger cities that are connected by electricity with Boston will have at least part of their mails carried over the electric railway, for the service, since it was inaugurated a month or two ago, has given such unbounded satisfaction, and has effected such a saving of time, that the public is loud in its praise. Each car runs about 40 miles a day, beginning between five and six A. M. and continuing until nearly eight P. M., when the night service begins. There is one mail clerk to each car and motorman and conductor. Of course the Post Office Department furnishes the clerk, the motorman and conductor being West End men.

As yet there has been no failure to make time according to schedule, and by Fall it is likely there will be many more similar cars in operation in the vicinity of Boston.

THE MORRIS AND SALOM ELECTRIC CARRIAGE IN PHILADELPHIA.

The first electric carriage on the streets of Philadelphia was put in operation on August 31, 1894, since which time it has been in constant use, except during the winter months, having travelled several hundred miles without any serious mishap or accident, all over the streets of Philadelphia, some of which are in very bad condition, and through parts of Fairmount Park.

The carriage, which we illustrate in the accompanying engrav-

THE MORRIS AND SALOM ELECTRIC CARRIAGE, PHILADELPHIA.

ing, was designed by the gentlemen occupying the seat, Mr. Henry G. Morris and Mr. Pedro G. Salom. Its total weight, including the battery, without passengers, is 4,250 lbs., the battery weighing 1,600 lbs. The maximum speed obtainable is 15 miles an hour and the maximum mileage on one charge 50 to 100 miles, according to speed and grades. Sixty cells of 100 ampere hour capacity are employed, having 13 H. P. hours capacity at the maximum discharge rate.

The motor is of the electric launch type, 3 H. P. nominal, built by the General Electric Co., and capable of developing, for a short time, 9 H. P., and weighs 300 lbs. It is connected through a pinion on end of the motor shaft to a countershaft having a balance gear to enable the wheels to move independently in turning curves. At the ends of the countershaft are pinions gearing

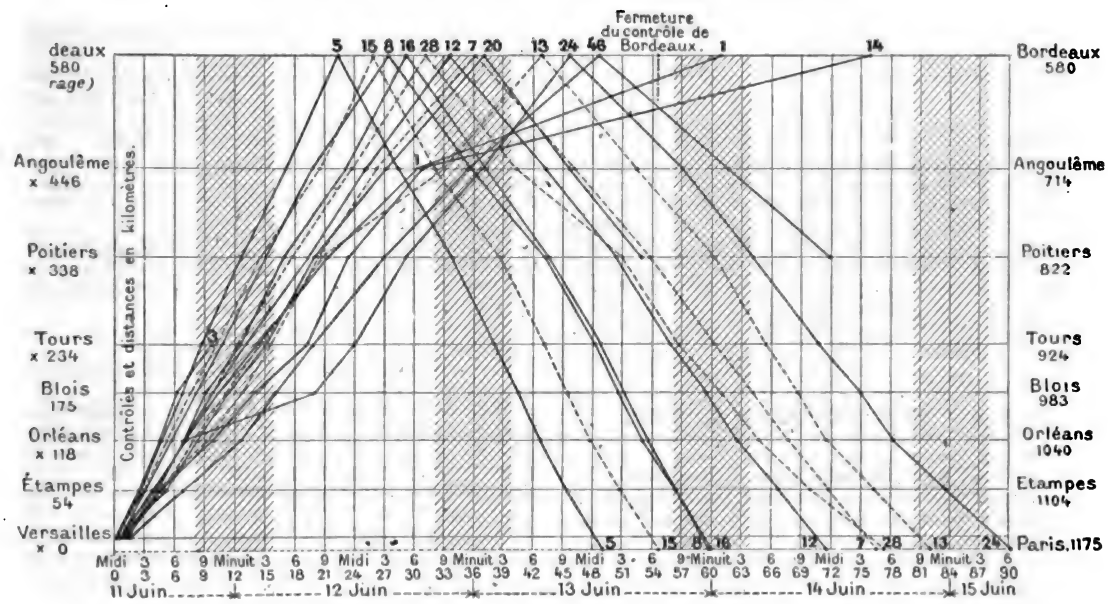


FIG. 3.—CHART SHOWING RECORD OF SELF-PROPELLING VEHICLES, PARIS–BORDEAUX RACE.

into large gears attached to the rear wheels of the wagon. The front of the wagon rests upon a fifth wheel of 30 inches diameter, which is attached by an iron frame to the rear axle. The lower half, and revolving part of the fifth wheel, rests on the springs between it and the front axle. This fifth wheel turns on hardened steel balls, being moved by a pinion and shaft with suitable reducing gear, which is operated by means of the hand wheel on top of the shaft, thus securing ample power as well as facility in steering. The controller regulating the current is placed in front of the foot board and is operated by shaft and crank immediately below the steering wheel.

This wagon was built merely to gather experimental data on the amount of battery and power required to drive over ordinary roads, and Messrs. Morris and Salom now have designs completed, based on the knowledge thus gained, which will make the new vehicles very much lighter for the various purposes for which they are designed. The present vehicle has a seating capacity for six, but there is ample power, if the seats were provided, to carry from 12 to 15 people.

THE PARIS-BORDEAUX SELF-PROPELLING VEHICLE CONTEST.

The recent remarkable performances of self-propelling vehicles in the prize competition over the road from Paris to Bordeaux and return, last month, has attracted attention deservedly to this method of propulsion. As a direct result of this competition, we noted last week a similar one just organized by the *Times-Herald*, of Chicago, to be competed for over the roads between Chicago and Milwaukee, while the announcement is also

FIG. 1.

made of a like contest organized by the London *Engineer*, with prizes aggregating 1,000 guineas.

The French competition was taken part in by no less than twenty-two vehicles, twelve of which arrived at Bordeaux within the limit of time set by the rules of the competition, and nine of these covered the distance of nearly seven hundred and fifty miles in less than one hundred hours. Of these nine carriages eight were driven by petroleum or gasoline motors, and a single one, that of M. Bollée, built in 1880, used steam. In describing the outcome of this contest, M. E. Hospitalier, in our excellent contemporary, *La Nature*, refers to the result as the incontestable and uncontested triumph of the gasoline motors, and as removing all doubts of the endurance of self-propelling vehicles.

The carriage which came in first in the race, illustrated in

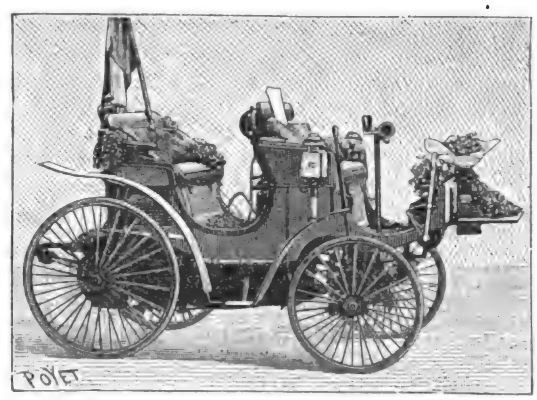


FIG. 2.

Fig. 1, was built MM. Panhard & Levassor, but did not receive first prize, as, according to the rules of the contest, the first prize was to be awarded to a carriage capable of holding four persons, or more. The first prize of 31,500 francs was awarded to the carriage illustrated in Fig. 2, which came in fourth in the race, and whose record is shown at line 16 in the chart Fig. 3, which shows graphically the result of the contests, the winning carriage being designated as number five. This graphical record shows in detail the principal incidents of the race, and the greater or smaller regularity in the pace of the carriages. Thus it will be seen that the last carriage arrived at Bordeaux almost at the same moment that the winning carriage No. 5 arrived in Paris, having made the record of 750 miles in 48 hours and 48 minutes. All the engines driven by gasoline motors which won prizes, show a perfectly characteristic curve, representing an inverted V, being the more regular the more uniform their speed, and the angle of the V being more acute the greater the speed. In this respect the record of No. 5 is irreproachable. In the chart the time elapsed is plotted as abscissæ, and the distances are as ordinates. The curves 1 and 3 are those of the steam carriage of M. De Dion, and No. 14 that of the bicyclette of Duncan & Suberbie, and No. 20 that of one of the steam carriages of M. Serpollet.

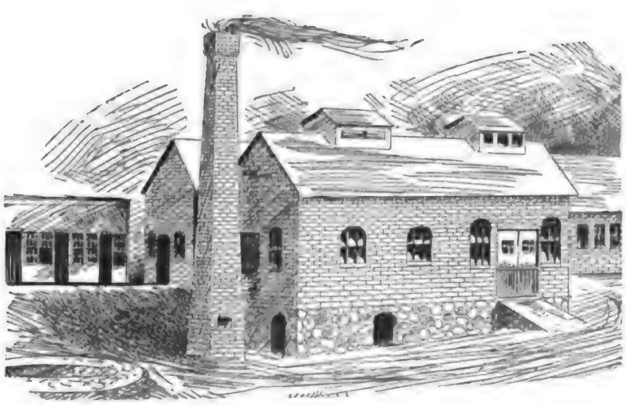
The results of this contest seem to show that the lightest vehicles proved best on the road, and this fact proves the superiority, according to M. Hospitalier, of gasoline and of essence of petroleum over every other known motive power. As a matter fact, other things being equal, it requires only .88 lb. of gasoline to pro-

duce 1 H. P. hour, whereas steam requires at least 6.6 lbs. of coal. As to storage batteries, according to M. Hospitalier, it would require more than 220 lbs. to obtain the same power during the same time. Light vehicles also allow of taking advantage of the employment of rubber tires; all the prize gasoline carriages were so equipped, and one, No. 46, was equipped with pneumatic tires, and covered the route of seven hundred and fifty miles without an accident to the wheels, notwithstanding its weight of 2,880 lbs. The ball bearings also contributed, in a certain measure, to the success of the gasoline motors. All the high speed steam carriages met with accidents, which seems to indicate that their weight, made necessary by the system employed, deprives them of the requisite qualities of a carriage of this nature. The essence of petroleum referred to as the fuel used in some of the carriages, is a product having a specific gravity between that of kerosene and gasoline, being about 10% lighter than the former.

THE GLOUCESTER AND ESSEX RAILROAD.

Among the trolley roads put in operation this season is the Gloucester & Essex (Mass.) Railroad which has just started running and which claims special attention owing to the length of travel which it will afford when all arrangements have been completed with contiguous roads.

The plant is located at a point midway between the Essex Falls station and the road known as Western avenue. Between this thoroughfare and the new buildings, runs the Falls brook, a water way of considerable magnitude, which carries the surplus water from Chebacco lake and empties it into Ipswich river. Over this brook, a substantial and ornamental bridge has been



THE GLOUCESTER AND ESSEX R. R. POWER HOUSE.

constructed, and rails are laid thereon connecting with the main line which runs along Western avenue. It is from this brook that the water supply for the boilers and condensers of the new plant is taken.

The plant consists of three buildings, as shown in the accompanying engraving, first to the left being the office building, a single-story wooden structure of simple architecture, in which will be located the offices. Next comes the brick and iron car shed, 200 feet long by 50 feet wide. The walls of the structure are of brick. The roof is entirely composed of steel, the light-looking but strong trusses being covered with corrugated sheet steel. This part of the work, as well as all the other roofs, was done by the Berlin Iron Bridge Company of East Berlin, Conn.

Four tracks extend the whole length of the shed, and they are connected together by means of a transfer table. The shed is designed to house 30 cars.

At the right of the car shed, is the boiler house, 40 feet square, and similar to the first building in style of architecture and construction. Here are three boilers, each is of 125 horse power capacity with room for one more of equal size. The boilers are from the Edward Kendall, Charles River Iron works of Cambridgeport, Mass.

The power is furnished by two independent triple expansion tandem engines from Messrs. McIntosh, Seymour Co., of Auburn, N. Y., each of 325 horse power. They are set on solid foundation piers of brick. The three cylinders are of 23, 22 and 12 inch diameter, with a stroke of 22 inches. The fly wheels are eight feet in diameter and each weighs over two tons.

Upon the same shaft as the fly wheel is coupled a Walker generator. Each of these generators has a capacity of 250 K. W. One of these engines and generators will be ample to operate the road. Should business increase to such an extent as to render the combined power insufficient, other engines can be placed alongside by an extension of the house, which has been provided for.

The cars for the line are mounted on Peckham trucks and supplied with two 30 H. P. motors, manufactured by the Walker Mfg. Co., of Cleveland, Ohio.

An understanding had been arrived at between the managers of the road and the Lynn & Boston Railroad, whereby the Gloucester tracks are to connect with those of the L. & B. at Beverly, and cars will be run over the tracks of the latter company, and use its power clear to Town House Square in Salem. This will make one of the longest electric roads in the country, as it will be possible to make the trip from Gloucester to Boston, a distance of about 33 miles, entirely by trolley.

The roadway has been built and equipped by the Worcester Construction Company, of Worcester, Mass., the mason work on the buildings by S. A. Burnham, of Essex, and the carpenter work by Pitman & Brown, of Salem.

GOOD BRAKES THE THING NEEDFUL.

THERE is a good deal of force in the suggestion of THE ELECTRICAL ENGINEER that good brakes are more necessary to street cars than the indifferently successful fenders which are in use. It is not for lack of good and quick-acting brakes that the feeble and out-worn hand brakes are retained. The inventors have devised power brakes by means of which the motorman, by a slight movement of the hand, can stop cars at a high rate of speed; but the companies do not adopt the improved appliances, because they cost more than the old.—*Boston Transcript.*

OPENING OF THE DETROIT CITY RAILWAY.

Dr. H. A. Everett, vice-president and general manager of the Detroit City Railway, writes us that the road is now in operation, the first car having been taken over the road by Mayor Pingree, who wore a motorman's uniform. The Company has about 27 miles all constructed and is operating already about 15 miles. The franchise covers 55 miles of track in the city proper and about 9 miles in the immediate suburbs. The road bed is laid in concrete in accordance with the Canadian practice of Dr. Everett and his associates; and it is believed that maintenance will be very slight for a number of years. The best that can be bought has been put in, and expense has not been spared in any department. The cars in use are of the combination pattern similar to those in use on Euclid avenue, Cleveland. The motors are of the latest Westinghouse make. The rail was rolled by the Cambria Iron Co. The poles are entirely of iron, and the overhead system was laid out for economical operation with a 00 trolley wire; all the details being got out by the Cleveland Construction Co. The Company has built a very substantial brick power house 150 feet by 270, with a brick stack 12 foot flue and 250 feet high. The engines are direct connected, cross compound Allis-Corliss, two of 600 H. P. and two of 1200 H. P. with Walker generators and Stirling boilers. It is expected to have power from the plant by September 1, and to have the line under pretty fair operating conditions by November, with 75 regular cars in service. The Company sells 8 tickets for a quarter.

HIGHER TROLLEY SPEED FOR BROOKLYN.

The speed at which the Brooklyn trolley cars now travel the streets of that city does not meet with approval of many of the business men, who claim among other things that the cars do not run even at the rate of speed allowed by the new city ordinance. These business men assert that many of their customers complain of the slow transit; and besides this, their business is injured materially, and now the merchants intend to petition the Board of Aldermen to modify the ordinance.

The Mechanics and Traders' Exchange has also gotten up a petition asking the Aldermen to increase the rate of speed. In the petition they say: "We do not advocate indulgence in any policy which will permit cars to be operated at a reckless pace, thereby imperiling human lives, but we do hold that a reasonable rate of speed is not inconsistent with perfect safety. Cars without fenders are propelled as fast as nine and twelve miles an hour on the crowded thoroughfares of Broadway and Third Avenue, New York, and we think a speed of ten miles an hour outside the crowded sections of Brooklyn should be permitted."

WORCESTER TO SPRINGFIELD BY ELECTRIC ROAD.

There seems to be a good prospect for the connection of Springfield and Worcester by an electric road. Work is soon to be commenced on the extension of the Worcester and Spencer line to West Warren which is expected to be in operation early in the fall. It is also expected that Palmer will connect with Springfield this year by a line to Indian Orchard. This will leave but an eight mile gap between Palmer and West Warren to be covered to complete the connection of Springfield and Worcester. This electric road will for much of the way parallel the Boston & Albany steam road.

ELECTRICAL INSTALLATION, MOUNT LOOKOUT COLLIERY, WYOMING, PA.

An excellent example of electrical coal mine operation is the installation at the Mount Lookout colliery at Wyoming, Pa., where locomotives, pumps and drills are being successfully and economically operated by electricity. This plant was installed by the General Electric Company and all the electrical apparatus employed is of its manufacture.

The source of power is a McEwen high speed engine making 218 revolutions per minute. It is located in the power house—a brick building some 200 feet from the main shaft, and about 100 feet from the air shaft. Belted to this engine are two multipolar General Electric generators, one of 100 K. W. (135 H. P.) capacity, the other of 20 kilowatt (28 H. P.) capacity. Haulage, drilling and pumping in the mine are operated by current from the larger generator while that from the smaller is taken for the incandescent and arc lighting circuits on the surface. In case of accident to the larger generator, the current from the smaller one can be utilized for power purposes.

From the two skeleton switchboards in the power house the circuits are lead, one to the surface the other to the mine. The office, engine and boiler houses are lighted by incandescent lamps; the breaker and surrounding grounds by 2,000 C. P. arc lamps.

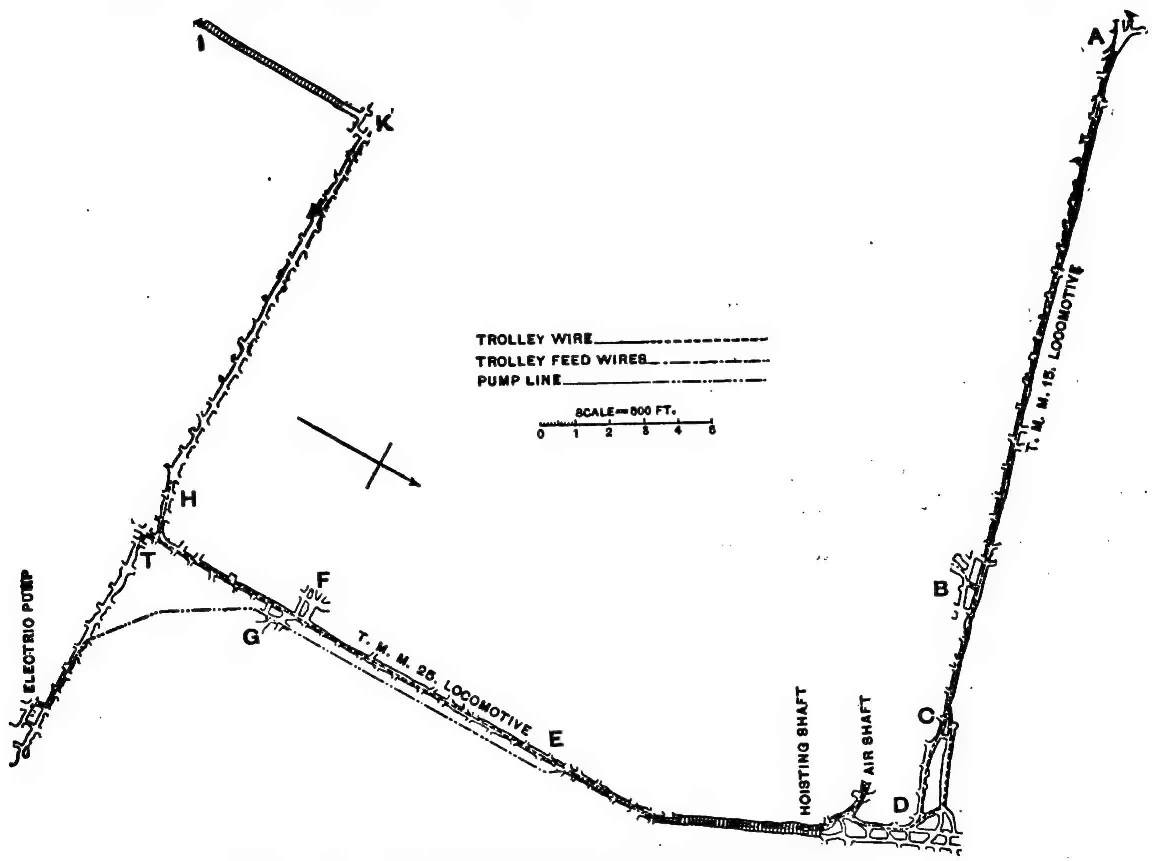
The conductors for the mine operations are strung 300 feet down to the bottom of the air shaft and consist of lead covered cables for the feeders and returns. The feeders are carried along the main gangways parallel to the trolley wire, or through old workings or air ways. The feeders are waterproof rubber covered copper wires strung on glass insulators attached to roof blocks.

At the bottom of the shaft the feeders divide, one branch supplying current to the North Workings the other to the South Workings. No. 0 hard drawn wire is used for the trolley wire the rails being bonded for the return. The trolley is suspended from oak roof blocks by a special mining ear which clamps the wire but is not soldered to it.

Haulage in the North Workings is effected by one electric locomotive which weighs about 6½ tons, equipped with two single reduction waterproof motors. It has a draw bar pull of 1,500 pounds on the level at 6 miles an hour, while at starting it will exert a pull of 3,500 or 4,000 pounds without slipping the wheels. The extreme dimensions of this locomotive are 11 feet 4 inches long, 57 inches wide and 34 inches high. The total length of the gangway over which it operates is about 2,800 feet, although including sidings and turnouts about 3,000 feet of trolley wire is suspended in the North Workings. The locomotive makes between 20 and 25 round trips per day. It is handling at present seven loaded cars, but is capable of easily hauling twice this number. The grades vary from the level to 2.8 per cent. and all are against the empties.

Haulage in the South Workings is effected by a locomotive equipped with two single reduction motors, and having a draw bar pull of 2,500 pounds on the straight level at a speed of 6 miles an hour. At starting, however, it can exert a draw bar pull of 4,000 to 5,000 pounds without slipping the wheels. The total weight of the machine is about ten and a half tons. It is 11 feet 4 inches long, 58 inches wide over all and 34 inches high. The maximum run made by this locomotive is about 1,200 feet, and the length of the wire used, including turnouts and sidings, is about 1,800 feet. At present this machine is hauling ten cars and making from 40 to 45 round trips pushing in the empties and hauling out the loaded cars. In starting from the entries F, G, H, and I where the trips are made up, the locomotive does its hardest work as there is a sharp grade and curve against the loaded cars. Each mine car empty weighs 3,000 pounds, and loaded 8,000 pounds.

The South Workings haulage line is to be extended from H to K and through a rock tunnel at L. The branches F, G and I will then be abandoned and the locomotive will then operate over about 3,500 feet hauling 400 cars per day from the head of the rock tunnel at L.



MAP OF ELECTRICAL CIRCUITS, MOUNT LOOKOUT COLLIERY, WYOMING, PA.

The electric pump is situated in the workings off the branch I. It is a standard duplex double acting piston Knowles pump operated by a General Electric motor, and has a capacity of 300 gallons of water against a 40 foot head. The piston speed is constant and should the water fall below the mouth of the suction pipe, the pump does not race. This pump has been in operation for more than a year, working twenty-three hours a day. It requires no attention except at starting and stopping, and an occasional oiling.

Two General Electric rotary coal drills are also in a low seam in the Southeast Workings of the mine. These are run from a circuit taken from that connected with the feeders in the main gangway. The length of this is about 1,400 feet. The drills are working a 3 feet seam of coal and taking up a 2 foot slate bottom. They make about 6 feet per minute with an inch and a half bit in the coal and 4 feet per minute in slate or "boney."

Since this electric plant was started it has operated without hitch or accident. Its installation has induced a decided economy in the operation of the mine, and is exciting considerable interest among coal operators, to whom it stands as an object lesson in the economical operation of mines.

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EDITORIAL ANNOUNCEMENTS.

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Communications for the Editorial Department should reach it not later than Thursday. Copy for advertisements should be handed in not later than Friday.

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CONTENTS.

HORSELESS VEHICLES.

THERE is perhaps no country in the world where art, science and industry are so much encouraged by the awarding of prizes for meritorious work and progress, as France; and although it might possibly be argued that no invention or appliance of the first order of importance was ever the direct outcome of a prize competition, still it is not to be denied that the origin of many advances can be traced to the stimulus of a prize competition. Even if such competitions do not always result directly in bringing out the desired improvement, they nevertheless draw attention prominently to the object in view and set to work many who would otherwise remain passive, if not in total ignorance of the needs of the times. We are led to these reflections in contemplating the results of the late self-propelled vehicle competition over the road between Paris and Bordeaux and return, which has attracted more than an ordinary amount of attention, and deservedly, as it touches so closely the question of cheap and rapid transportation. To look upon the results of this competition merely in the light of a race organized by wealthy amateurs with a fad is to ignore the philosophy of the history of transportation, and more particularly the most recent part of that history as embodied in the annals of the electric railway for the last ten years.

The horse has already been practically banished from the streets of American cities as a popular means of passenger transportation and gradually but surely the rest of the world will follow American example. But the highway and country road still afford an asylum to the horse; yet even here, as the recent contest in France has shown, he is not safe from competition.

The result of the race demonstrated the remarkable qualities of the petroleum motor over a course covering such a distance and must have been a disappointment to those who had cherished hopes for the success of the electric carriage which entered the lists. The result so far as the electric carriage was concerned might have been foreseen. We have never been accused of lukewarmness in advocating the adoption and application of electricity to any useful purpose suggested, but a consideration of all points involved leads us to the unavoidable conclusion that for *long distances such as those covered in the Paris-Bordeaux contest* the electric storage battery carriage is not yet available. As shown in another column, it requires 250 lbs. of battery and motor to produce one horse power hour, and handicapped in this fashion it is useless to pretend that the storage battery can compete with power directly applied by a prime mover weighing less than one quarter of the necessary electrical equipment. Granted even that a lighter form of storage battery may make it possible to reduce the weight; even the copper-alkaline cells would hardly reduce the weight of battery more than one-third. We have in the above comparison considered the electric storage battery carriage in the light merely of a long-distance traveller, but while compelled to admit its inferiority under such conditions, we are by no means ready to concede like superiority for the petroleum motor for the ordinary distances to cover which wagons are usually employed. After all, the French contest was a *tour de force* and it is doubtful if any one desirous of going from Paris to Bordeaux and return on business would dream of selecting the wagon road instead of the steam railway. To that extent, therefore, it is necessary to modify the opinion which one is apt to form at the start in studying the record given on another page. The first consideration in modern travel is comfort, and this holds true as well for short as for long distances. It is this requisite, aside from the question of speed, which has

made the stage coach and omnibus a memory in most civilized countries, and has given the electric car the popularity it enjoys. Granted, then, the conditions of short haul (which is the normal work of a road carriage), and maximum comfort, we are not alarmed for the future of the electric carriage. On the contrary, comfort being the first consideration in vehicles of this type the comparison as between a heat engine of any description whatever and the electric motor, becomes almost ludicrous. Far, therefore, from losing courage, those who are devoting their attention to the construction of electric carriages should redouble their efforts. The several recent designs of electric carriages actually constructed and the one illustrated in this week's issue give evidence of intelligent thought, and with the improvements suggested by their operation in practice, we may soon expect the creation of a regular demand for such vehicles. Nor must it be forgotten that there are other means of electric propulsion to which ordinary road vehicles are well adapted and that the trolley carriage fed by current from overhead conductors is by no means as remote as it would appear to be. Requiring no outlay whatever for track construction and repairs, rights of way, etc., a system of electric trolley carriages might in many instances be found profitable where a railroad would not pay. It might appear as a begging of the question to put forward the trolley carriage in a discussion of self-propelling vehicles, but we mention it merely to show that the methods at disposal for electrically driven vehicles are by no means confined to the storage battery, while naturally the energy supply of all other types of carriages is limited to their fuel carrying capacity.

All indications point to a rapidly growing interest in vehicles of this class, an interest which is stimulated by the announcement of two new competitions,—that organized by the *Times-Herald*, of Chicago, with \$5,000 in prizes, and the other by the London *Engineer*, which holds forth incentives in the shape of prizes aggregating one thousand guineas. These competitions will enable American and English inventors to test their vehicles of this class and will afford a useful means of comparison with those of French design.

SPIDERWEB RAILROADING.

WHATEVER may be the motive power in the future of long distance travel, it is certain that suburban and interurban work has already fallen into the hands of the electrical engineer. There is no longer any conjecture about this matter, nor any serious argument. It has ceased to be a question of change and has become simply a question of the manner in which the change will be effected, or of the time it may require to take place. The change is not to be delayed because Col. Hain of the New York Elevated pretends to doubt the ability of electricity to handle his traffic, and it is not less certain because the New York Central even in these days of extreme heat suffocates its passengers with steam, sulphur and soot in its Harlem tunnel. Neither a company nor an individual can now stem the current, but they who are in power can do much to give it proper direction. It would be more frank on Col. Hain's part to admit that the cable roads are depriving the elevated roads of much of their traffic and that he has, hence, less money and credit available for the introduction of the new motive power and the abandonment of the old. Anybody who watches any day of the week the travel on the Third Avenue cables or that on Columbus Avenue with its crowded transfers to the conduit electric road on Lenox Avenue has no trouble in determining what is the matter with the Elevated. The inability of electricity to handle large travel on an elevated structure, even if it were a true plea, has nothing to do with the case; and, moreover, we all know that it is not true.

But turning to suburban traffic, we find the change in full operation. It is reported from Boston that the success of the Nantasket Beach road has already set the town talking and that the travelers on many other short branches centering there are anxious to know how soon they can enjoy electric travel with its many incidental advantages. This week the Burlington & Mt. Holly branch of the Pennsylvania road is to be put on full running schedule, and several other branches are now named as ripe for change. From Chicago comes the news not only that the Chicago & Northern Pacific is to convert its local lines but that the Illinois Central is already obtaining bids and estimates for such work. Last week saw the displacement, it is reported, of the last steam dummy in local travel at Kansas City. These are all very significant indications, and lose none of their importance because of their remoteness from slow and timid New York.

Looking yet further afield, it is evident that a transformation is in full progress in "interurban," as distinguished from "through" travel. The *Street Railway Review* has just made a compilation of all such projects, a large number of which are already begun, and shows them to number 190 with a total of 3,457 miles, located in no fewer than 31 states. The longest is 100 miles—Bellefontaine to Lima, O.—and there are several above 40 miles. These roads appear to us to group into three classes. The first comprises roads that take the place of steam roads that would have been built sooner or later. The second, includes roads that parallel steam roads and compete on superior terms for their traffic. The third class, chiefly of short roads, embraces a large number of little links between adjoining cities near enough to make light travel pay, but not offering in any case sufficient return had the old ponderous steam methods been adhered to.

It is above all curious to note how these roads reticulate the country, constituting as well by their number as by their lightness of construction, a veritable spiderweb of tracks. Ohio for example, has no fewer than 31 of them and little Massachusetts has 14. They are not necessarily straight, but bend and curve and fetch in a most delightful manner, the object of a great many being to pick up all the way travel possible. The maps of some that have been produced in our columns exhibit them as preferring the highway very decidedly to direct cuts across pasture and furrow; and when they reach a town they go into its heart instead of locating a station one mile out. There can be no doubt at all that they are going to develop a habit of travel among large masses of people hitherto untouched by the restlessness of the times; and it is equally obvious that they must shift no few centres of local trade and distribution.

Another element that strikes one in this interurban work, although it is not shown in the figures of the *Review*, is that a large mileage counts upon the utilization of water-power. Whether in the long run there will be enough of this to affect the extent of coal mining is not quite clear, but it will surely give a value to many natural powers now running to waste. The brilliant success of such work is seen at Niagara where a plant taking two or three thousand horse-power from the Canadian side of the Horseshoe operates admirably a standard road 13 miles long, double track; but in some instances there will probably be disappointment as to the amount of power available and the cost of utilizing it. The likelihood is that we shall soon witness a widespread adoption, in this branch of electric railway work, of the modern phase methods of transmission with rotary transformers. This has already been tried successfully in New England, and has even been adopted for the new trolley system in Dublin, Ireland. It would appear that with high voltage phase transmission, and rotary transformers judiciously placed, some notable economies will soon be recorded in interurban electric railway work, both on roads using coal in the power-house and on those using water or natural gas.

MEETING OF THE NORTHWESTERN ELECTRICAL ASSOCIATION.

The third convention of the Northwestern Electrical Association was called to order at the Leland House, Chicago, on Wednesday, July 17, by Vice-President George Grimm. In his opening address he spoke feelingly of the great loss which the Association had sustained in the death of their late President, Henry C. Thorn, and paid a glowing tribute to the ability and high character of the departed.

The speaker dwelt at length on the constant war waged against companies operating under public franchises. Inquiring into the causes which have dulled the sense of justice in the people Mr. Grimm said: In our case the cause should not be hard to find. How many corporations who are enjoying valuable franchises granted to them as gifts by municipalities conduct their business with any other thought or object in view than the profits to be made. They will improve the service or extend their lines if they must, or if they will gain additional patronage; but every move is actuated either by expected gain or public (municipal) compulsion. Complaints of poor service, irregularity, overcharge, and the like, are utterly ignored until recognition is compelled by public sentiment or authority. Competition is kept out, destroyed, or made harmless by combinations. Every effort is directed to the earning capacity, frequently for the purpose of forcing, by its dividend qualities, a stock, originally watered, up to par. Every concession requested by the community that gave it the possibility of existence is resisted until the patience of the public is exhausted and sentiment becomes inimical to an industry that should have received united support and commendation. This sentiment of dislike, and clamor for municipal ownership of the quasi-public industries like electric lighting, gas works, waterworks, and the like, is the natural outgrowth of either unduly large profits extorted by the line of policy above referred to, or by lack on part of the managers of proper regard for the rights of the people. I fail to find any other cause. The root of it all is that some of these corporations seem unable to realize that their business is not strictly private but semi-public in its character, and should be managed accordingly. While undoubtedly most of these industries are run upon a broad gauge plan, regardful and mindful of the rights and wishes of the public, yet it must be evident to all that there are many that are liable to every charge of the evils complained of. The public never stops to discriminate in passing judgment, and the result is that the general sentiment becomes hostile to all alike and ready to accept any plan of relief or retaliation which may be suggested even as against industries which are not at fault and which would innocently suffer. Thus the agitator and pot-house politician find ready soil to receive their seeds of communistic doctrine and willing ear for the abuse of others and self-glorification

The following are now the officers of the Association:—President, George Grimm. First Vice-President, Pliny Norcross. Second Vice-president, P. H. Korst. Secretary, William Goltz. Treasurer, John Schuette.

The following members, associate members and friends were in attendance A. V. Abbott, M. B. Austin, C. O. Baker, F. N. Boyer, Lewis Brittan, A. C. Bunce, Loren W. Burth, Chas. G. Burton, G. L. Cole, Carroll Collins, L. H. Cooke, F. A. Copeland, Crouse-Tremaine Co., George Cutter, Fred De Land, F. E. Donohue, George A. Farwell, W. J. Ferris, Channing S. Gage, William Goltz, C. E. Gregory, George Grimm, T. F. Grover, G. Gunderson, Eugene Hall, J. H. Harding, E. M. Highlands, M. Hussey, W. D. Jameson, P. H. Korst, R. F. Kountz, H. D. Latimer, S. P. Lord, W. W. Low, A. G. Luthy, G A. McKinlock, George S. McLaren, John C. McMynn, John R. Markle, Chas. S. Marshall, F. McMaster, E. P. Maxwell, T. R. Mercein, S. F. B. Morse, G. M. Newton, Pliny Norcross, Robert W. Ney, F. Overbagh, C. C. Paige, J. S. Paulson, O. M. Rau, W. C. Remington, John Schuette, J. Stedman, J. S. Stephens, M. L. Stevenson, B. S. Terry, W. H. Thorp, W. H. Upham, John Valentine, M. A. Warren, John B. Whalen, M. C. Wheaton, George Whyte, Theo. Wilberling, J. F. Wiley, C. D. Wilkinson, R. A. Wilson, W. Wilson, James Wolff, H. O. Woodruff.

At the conclusion of the president's address, the following papers were read and discussed: "Central Station Economies," by J. S. Stephens; "Electrical Interference," by A. V. Abbott.

In the afternoon a number of the visitors took the Metropolitan Elevated Railway and inspected the power house and repair shops of that road. On the return trip they visited the Chicago Edison Co.'s new Harrison Street Station where Mr. Louis A. Ferguson, electrical engineer of the Company, showed them the many features of interest to be seen in that magnificent plant.

On Thursday the meeting opened with a paper by W. D. Jameson on "Boiler Feedwaters; their Treatment," followed by a paper by George Cutter on "Electric Street Lighting."

At two o'clock a goodly contingent left by special train on the Santa Fé R. R. to visit the works of the Drainage Canal, and during the trip Messrs. Morse and Wolff of "Kerite" and "Grimshaw" fame, most hospitably regaled the hot and thirsty travelers with Milwaukee's very best brew. Messrs. Chas. E. Gregory, A. C. Bunce, and Chas. Valentine the other members of the entertainment committee were the right men in the right place and were untiring in their efforts to give their guests a good time and succeeded admirably.

In the evening, a party visited the Columbia Theatre to witness the performance of the "Merry World," and during the progress of the play the names of many well known members of the fraternity were frequently mentioned.

On Friday morning the following papers were read: "The Choice of Transformers," "The Advantage to be derived by testing every Transformer before placing it on the line," by Prof. D. C. Jackson. "Boilers and Practical Specifications for the Building of Same," by J. C McMynn.

In the afternoon a very enjoyable coaching trip was made to Jackson Park, and on the way the party stopped at "Ye Inn," where Mr. S. F. B. Morse most hospitably entertained all those who were fortunate enough to be on the excursion. On the return journey Mr. Geo. C. Bailey invited the party to stop off at the Hyde Park Club, where he generously attended to their inner wants, after which the party drove back to the city.

EXHIBITS.

The General Electric Co. exhibited their arc lamps, incandescent lamps, watt meters, switches, and other station supplies.

The Western Electric Co. had a variety of arc lamps and auxiliary apparatus on exhibition.

The Columbia Incandescent Lamp Co. had a very nice line of their well-known lamps exhibited, which were in charge of Mr. Jos. M. Hill, their Chicago representative, who had also on show one of the Wagner Electric Co.'s transformers.

C. E. Woodruff Co. showed flexible conduit manufactured by the American Circular Loom Co., also wire and other supplies.

L. B. Allen exhibited his well-known soldering stick, which was also to be seen in most of the other supply exhibits.

The Mason Electric Co. had a line of the Fiberite Co.'s specialties, also lightning arresters, oil filters, etc.

The Buckeye Engine Co., Salem, O., showed a fine model of one of their class "B," medium speed, simple horizontal engines, which had the top of the cylinder off so as to show the working of the slide valve and cut-off.

The Hart & Hegeman Mfg. Co.'s interests were looked after by their wideawake representative, Mr. Geo. S. Searing, who had on show a new adjustable incandescent light balance, manufactured by Gillespie & Taett, Edwardsville, Ills.

The Sioux City Electrical Supply Co. showed some overhead railway supplies and electrical specialties.

The Electric Appliance Co. had a very nice exhibit of Paranite cocktails and Packard punch, and as usual did a roaring trade. Mr. Chas. Wells waited upon the customers in his usual pleasant style.

The Fort Wayne Electric Corporation had an interesting exhibit of a liquid description to which there were many visitors, upon whom it had an electrical, but by no means a shocking effect.

The Hayes Fyfe Co, Chicago, had two of their automatic motor starting rheostats on view, which were regarded with great interest by the many visitors to their exhibit.

The Osburn Electric Supply Co had a very neat exhibit of electrical specialties.

The Dearborn Drug & Chemical Co., Chicago, were in evidence with their well-known vegetable boiler compound, and showed some samples of what bad water can do in the way of producing some very tough-looking specimens of incrustation that were taken from steam boilers. They presented all visitors with one of their very neat leather bill cases, which were highly appreciated by the recipients.

S. F. B. Morse & Co. had a very neatly printed round cardboard souvenir, with a picture of the genial head of the firm in the centre, and "Day's Kerite," in prominent letters, all round the edge.

The Sunbeam Lamp Co. were represented by Messrs. F. S. Terry and A. S. Terry, who were very busy amongst their numerous friends in the interests of their well-known lamps.

Chas. E. Gregory was around, brisk as a bee, and at the same time had a sharp eye to business.

The Roberts Electric Co. showed one of Mr. H. J. Roberts' new patent wood boring machines, which does good and quick work.

E. Nashold was present looking after business for the Nashold Cleat Co.

CENTRAL STATION ECONOMICS.[1]

BY J. S. STEPHENS.

The author believed that the location of an electric light or power plant has as much to do with its success as almost any other factor and hence strongly urged the necessity of employing a reliable and experienced electrical engineer to decide on the location of the plant. The buildings should be substantial and

1. Abstract of a paper read before the Northwestern Electrical Association, Chicago, July 17-19, 1895.

laid out with a view to certain increase. Care should be taken in the selection of apparatus and not too much confidence should be placed in the usual guarantees of efficiency. When the station is in operation a thorough system of keeping books and records will serve to indicate in what direction economies are possible in the future.

ELECTRICAL INTERFERENCE.[1]

BY A. V. ABBOTT, C. E.

THE author discussed the subject of interference of circuits carrying different currents and divided these disturbances into the following classes: 1. Leakage. 2. Inductive disturbances—(*a*) electro-magnetic, (*b*) electrostatic. 3. Common path interference. 4. Electrolytic action.

To avoid the first, leakage, good construction and insulation of the circuits was indispensable.

Inductive disturbances of an electro-magnetic nature could be avoided by so locating the disturbing conductors with relation to each other as to neutralize the induced currents, such as by transposition either of the disturbing or the disturbed circuit. A remedy might also be found under certain conditions by opening the disturbed circuit either by a condenser or by the introduction of an impedance of such dimensions that it will choke out the objectionable impulses, while permitting the desirable ones to pass.

Electrostatic induction is hardly likely to play any important part except in telephonic installations. It is the most difficult form of induction to cure, as neither impedance coils or condensers have a marked effect as a remedy. The method of transposition is also comparatively inoperative, the only radical cure, apparently, being the removal of the interfering circuits to a considerable distance from each other.

The remedy for disturbances due to "common path returns," such as the earth, are complete metallic circuits; in the case of electric railways much could be done to avoid these difficulties by proper bonding of the rails.

Regarding the avoidance of electrolytic action the author advocated the employment of the double-trolley system in railway work.

BOILERS AND SUGGESTIONS FOR BOILER SPECIFICATIONS.[2]

BY J. C. MCMYNN.

The author began by giving actual examples showing how the cost of steam consumption in several plants was materially reduced by the introduction of improved apparatus. He then gave a brief account of the material requisite in boiler construction, and followed this by a specification of a steel tubular boiler.

BOILER FEED WATERS: THEIR TREATMENT.[3]

BY W. D. JAMESON.

THE author enumerated the various impurities met with in boiler feed waters, such as the salts of lime, magnesia, potassium, iron, silica and aluminum, combined with carbonates, hydrochloric and sulphuric acids. The only substances which can be successfully used in the boiler to break up and convert sulphate of lime into a form in which it can be readily washed out, are sugars properly blended, which, when used under the high heat and the existing conditions of the steam boiler, convert this sulphate of lime into a complex mixture of saccharates and carbonate of lime, and this in the presence of the tannin matters, is partially converted into tannates of lime.

Of all the deleterious actions which take place in steam boilers electrolysis or galvanic action is the easiest to handle, for one simply needs to satisfy the water with some vegetable starch and saccharine matter, and in that way break up the conductivity between the negative and positive poles, whether they be brass connections (negative) and the boiler plate and flues (positive) or the iron of the boiler plate.

Scaling ingredients are converted from crystallizable scale forming carbonates and sulphates having a great affinity for hot metal, into non-crystallizable tannates and saccharates of lime and magnesia, being a complex mixture of these with some carbonate, the sodium salts being readily handled in the same manner. This complex mixture of the saccharates, carbonates and partially converted tannates, is of an inert nature, having the physical properties of a soft oozy mud of the same specific gravity as the water, and no affinity for hot metals; neither has it the clay-like properties but will readily wash out with the water when cleaning the boiler.

The author also gave his experience in the avoidance of other deleterious actions in boilers, and concluded by showing the destroying action of oil in boilers which forms heavy compounds with the salts in the water, and settling at the bottom causes overheating and dropping down of the sheets and the buckling of tubes. Oil could best be handled by means of tannin extracts.

1. Abstract of a paper read before the Northwestern Electric Association, Chicago, July 17-19, 1895.

2. Abstract of a paper read before the Northwestern Electrical Association, Chicago, July 17-19, 1895.

3. Abstract of a paper read before the Northwestern Electrical Association, Chicago, July 17-19, 1895.

SOCIETY AND CLUB NOTES.

MASSACHUSETTS ELECTRIC LIGHTING ASSOCIATION.

The Massachusetts Electric Lighting Association visited Nantasket Beach, Boston, on July 18, to the number of 85 for the annual meeting. The trip down was made by steamer, and as the guests of the New York, New Haven & Hartford Railroad Company, the members made a tour of the Nantasket Beach electric branch on a special train and inspected the power house. Upon their return from this trip the party took carriages to the Atlantic House, where a banquet was enjoyed.

At its business meeting, the association elected these officers: President, F. A. Gilbert, Boston Electric Lighting Company; vice-president, Hon. Theodore C. Bates, Worcester Electric Lighting Company; executive committee, C. L. Edgar of Boston, H. S. Cogswell of Fitchburg, C. C. Frye of Lynn, F. S. Richardson of North Adams and F. S. Almy of Salem.

PERSONAL.

DR. NIKOLA TESLA has had the Order of the Eagle conferred upon him by the Prince of Montenegro. He has already received the Order of St. Sava from the King of Servia.

STANDARD ELECTRIC CO.

Probably no exhibit at the Northwestern Electrical Convention attracted more attention than the new arc lamp recently placed on the market by the Standard Electric Company of Chicago, and of which more than a thousand are now in use. In exterior appearance it is similar to the former type of Standard lamp, but when the cover is lowered, the marked simplicity of the mechanism is apparent. As this lamp is a prime favorite with Mr. Perry, it was perfectly natural that he should find pleasure in debating on its good qualities; how the potential of the arc remained just the same regardless of the position of the clutch, the lamp magnets always being in perfect electrical balance; how an instantaneous and silent arc was always assured; how the arrangement of the magnets does away with the necessity of perfect cleanliness to insure economical and satisfactory service. It is claimed that the potential of the arc never rises above 50 volts or drops below 46, and though the amperes should vary from five to fifteen, still the arc will form silently and instantaneously at the normal voltage and so remain. As the contact points in the automatic cut-out are of platinum there is no corrosion and the lamp cuts out without a spark. For conducting the current to the carbon rod there is a substantial brush capable of carrying more than 20 amperes. The brush is so arranged that the friction upon the rod is reduced to a minimum. For outdoor service each lamp is provided with a double pole weatherproof switch which is enclosed in a compact "detachable cap" and is so constructed as to permit the lamp being instantly removed from the line without opening or breaking the circuit.

COLUMBIA INCANDESCENT LAMP CO.

Mr. J. H. Rhotehamel, president of the Columbia Incandescent Lamp Co., of St. Louis, writes hopefully with regard to the lamp situation, and reports business as being equal to that of former years, and in fact much better than it has averaged of late. Columbia lamps are good and must always be in demand. Mr. Rhotehamel believes that the public is rapidly educating itself on the lamp question and knows a good thing in lamps when it sees that same. The Columbia Company has been a leader in this educational work, and Mr. Rhotehamel says that its efforts are being steadily rewarded by a substantial increase in business. Columbia goods are becoming extensively known and used, and deserve the appreciation they enjoy.

A WOMAN TO BE GERRYCIDED.

MARIA BARBERI, an Italian girl who killed her blackguard lover with a razor, has been condemned to death by electricity. If she is executed, she will be the first criminal disposed of in this way

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JULY 16, 1895.

Alarms and Signals:—

Automatic Railway Signal, A. J. Griffin, Wilkes-Barre, Pa., 542,638. Filed Aug. 7, 1894.

Electric Annunciator, H. C. Thomson, Boston, Mass., 542,664. Filed Oct. 2, 1894.

Cable Railway, W. M. Wood & J. C. Miller, Elmira, N. Y., 542,670. Filed May 29, 1894.

Device for giving an alarm at the power house in case of accident.

Burglar Alarm Circuit Closer, A. A. Vanderpool, Newark, N. J., 542,697. Filed Nov. 8, 1894.

An improved form of window spring.

Railway Signal, F. B. Wetherbee, Walpole, Mass., 542,699. Filed May 3, 1895.

Electric Block-Signal for Railroads, A. C. Gordon, Rochester, N. Y., 542,761. Filed May 18, 1895.

Electric Signal Apparatus, T. B. Keeler, Rahway, N. J., 542,769. Filed Mch. 11, 1895.

Relates to the so-called "electric slot mechanism" signal.

Fire Alarm, J. R. McCoy, Marshalltown, Iowa, 542,775. Filed April 8, 1895.

The alarm circuit is controlled by a thin thread placed on the walls and ceilings of the apartment, and which is readily destroyed by the heat.

Fire Alarm Device, J. F. Snapp, Frichton, Ind., 542,788. Filed April 18, 1895.

A thermostat in which the fusible material is a bar of celluloid.

Annunciator, J. W. Olson, Chicago, Ill., 542,883. Filed Nov. 21, 1894.

Details of construction.

Electrical System for Signalling Between Trains, A. Basanta y Baqua, Madrid Spain, 542,916. Filed Jan. 21, 1895.

Conductors are placed parallel with the track and contact made by arms carried on the cars.

Electric Annunciator, W. J. Clarke, Trenton, Can., 542,926. Filed Feb. 5, 1895.

Eleven connecting wires are required for the first ten rooms, after which only one additional wire is required for every ten rooms up to one hundred rooms, and after that only one additional wire for every one hundred rooms.

Signaling Apparatus, L. S. Crandall, Parish, N. Y., 542,928. Filed Feb. 17, 1893.

A compound monogram studded with lamps which are lit by a combination switch in the form of a key board.

Distribution:—

Means for Generating Electricity from Car-Wheel Axles, M. Moskowitz, Newark, N. J., 542,771. Filed Feb. 27, 1895.

Details relating to car lighting from a dynamo driven by the car axle.

House Wiring Fixture, C. F. Case, Akron, Ohio, 542,994. Filed April 20, 1895.

A combination insulating tube for gas pipes and electrical conductors.

Regulator for Alternating Electric Currents, C. P. Steinmetz, Schenectady, N. Y., 542,968. Filed Feb. 16, 1895.

A primary or inducing member having an exciting winding coupled in shunt across the circuit to be regulated and a secondary member having a corresponding winding in series with one of the circuit mains. The two members of the regulator are adjustable.

System of Electrical Distribution, G. W. von Siemens, Berlin, Germany, 542,979. Filed April 26, 1893.

A four wire system with automatic regulating devices for maintaining constant potential by counter-electromotive force of said devices.

Dynamos and Motors:—

Regulation of Continuous Current Motors, M. J. Wightman, Scranton, Pa., 542,667. Filed April 2, 1895.

Permutes the number of poles, so that the motor is changed from a two-pole to a four-pole motor or vice versa—to obtain variations of speed and torque.

Galvanic Batteries:—

Elements of Galvanic Batteries, F. A. Von Alimonda & N. Von Alimonda, Castello Alimonda, Near Sagrado, Austria-Hungary, 542,953. Filed Oct. 30, 1894.

A hook shaped connection is embedded in the carbon electrode.

Lamps and Appurtenances:—

Carbon for Electric Lamps, H. F. Cabirau, Paris, France, 542,695. Filed Apl. 11, 1895.

Consists of two pencils nested together, the inner pencil being provided with a central opening and radial channels or air passages between the nested pencils.

Electric Arc Lamp, E. Thomson, Swampscott, Mass. & C. E. Hartman, Lynn, Mass., 542,662. Filed June 25, 1894.

The control of the feeding is directly dependent upon the action of the controlling magnet irrespective of its adjustment for the arc length.

Measurement:—

Electric Measuring Instrument, E. Thomson, Swampscott, Mass., 542,663. Filed Apl. 25, 1895.

Details of construction relating to alternating current voltmeters or ammeters.

Electric Meter, H. A. Rowland, Baltimore, Md., 542,945. Filed Apl. 19, 1895.

Consists in supporting the coils of the meter by the same non-magnetic conductor which produces the damping effect by its revolution in the magnetic field.

Miscellaneous:—

Electric Governor, W. W. Handy, Lake Roland, Md., 542,640. Filed May 1, 1895.

Designed especially for governing water wheels.

Stop Cock Lock, C. Heyman, New York, 542,642. Filed March 20, 1895.

An alarm is given when faucets have b en carelessly left open.

Stop Cock Lock, C. Heyman, New York, 542,643. Filed April 23, 1895.

Similar to the above.

Insulating Shield for Metallic Poles, W. J. Braley, Fall River, Mass., 542,675. Filed April 17, 1895.

Sub-Marine Mine, W. H. Huskisson, London, Eng., 542,732. Filed Nov. 22, 1894.

A Hughes induction balance contained in the mine has currents induced in it on the approach of a ship, which currents act to close the circuit that explodes the mine.

Apparatus for Automatically Displaying Advertisements, C. K. Marr, London, Eng., 542,802. Filed Sept. 18, 1894.

Time-Recorder for Water-Gauges, E. P. Wells, Highlands, Colo., and E. R. Hubbard, Walden, Colo., 542,910. Filed Feb. 25, 1895.

Separating Metals from Foreign Substances, H. H. Whitacre & A. C. Wolfe, Wellsville, O., 542,911. Filed Feb. 14, 1895.

Coils surrounding the pipe extract from any liquid or viscid matter all steel or iron particles or filings which may be held in suspension.

Electric Gas-Lighter, H. G. Grier, Philadelphia, Pa., 542,959. Filed May 31, 1895.

An automatic electric gas-lighter particularly adapted for "Welsbach" burners and which may be carried wholly by the shade-holder and can be made detachable.

Railways and Appliances:

Running Gear for Electric Railways, B. J. Arnold, Chicago, Ill., 542,617. Filed April 13, 1891.

An improved method of motor suspension.

Switches, Cut-Outs, etc.:—

Fuse Holder, L. C. Orrell, Bellevue, Ky., 542,713. Filed Oct 22, 1894.

Make and Break Switch, M. Moskowitz, Newark, N. J., 542,772. Filed April 23, 1895.

Details of construction.

Polarized Compound Switch, M. Moskowitz, Newark, N. J., 542,773. Filed May 2, 1895.

Pole changer to be used in connection with dynamos, subject to armature reversal.

Electric Switch, G. T. Eyanson, Philadelphia, Pa., 542,848. Filed May 10, 1895.

Relates to a knife snap switch.

Telephone Relay or Repeater, C. H. Arnold, Boston, Mass., 542,618. Filed March 16, 1895.

Embodies a double bridge between the conductors of the main line and two local repeating circuits controlled by the two receiving magnets, with induction coils having two secondary windings one-half on either side of the bridge, and their primaries in the local circuit.

Telephonic Repeating Circuit and Apparatus, C. H. Arnold, Boston, Mass., 542,619. Filed March 16, 1895.

Modification of the above. A condenser is interposed in the bridge whereby it is divided conductively, but left inductively continuous.

Telephone Relay Apparatus, W. L. Richards, Malden, Mass., 542,657. Filed March 16, 1895.

Embodies artificial balancing circuits of suitable resistance and capacity, one for each main circuit.

Telephone Repeating Circuit and Appliance, W. L. Richards, Malden, Mass., 542,658. Filed March 16, 1895.

Embodies a polarized switch in connection with the relay magnet.

Telephones:—

Coin Controlled Telephone, C. B. Hopkins & T. H. Elson, Spokane, Wash., 542,679. Filed March 16, 1894.

Microphone, H. Carbonelle, Brussels, Belgium, 542,892. Filed Oct. 9, 1894.

The microphone button is free at one end, while the other is rigidly connected with the vibrating plate by means of a hollow elastic tube which is smaller and shorter than the former.

Telephonic Relay or Repeating System, C. H. Arnold, Boston, Mass., 542,918. Filed March 16, 1895.

For description see page 93, this issue.

REPORTS OF COMPANIES.

PERKINS ELECTRIC SWITCH CO.

The Perkins Electric Switch Company of Hartford has increased its capital, says the Hartford, Conn., *Courant*, from $50,000 to $125,000, by adding 750 shares at $100 each, all paid in. The new stock has been subscribed for by the following: C. G. Perkins, 400 shares; Roland Mather, 150; Edward W. Hooker, 50; J. M. Allen, 25; James Nichols, 25; E. C. Frisbie, 50; P. H. Woodward, 20, and Talcott Brothers, Talcottville, 80 shares.

THE GENERAL ELECTRIC-WESTINGHOUSE "DEAL."

The *News Bureau* of Boston in a long article on the failure of the negotiations for an understanding and agreement between the Westinghouse and General Electric Companies says:—

The report that negotiations had been renewed about four weeks ago was practically acknowledged, but later it was reported that Mr. Coffin was working upon a plan which he would soon offer to the Westinghouse Co. for final acceptance or rejection.

The most interesting feature of the story is the explanation of why these negotiations failed. It seems that it was due to the action of members of a couple of banking houses having close relations on important matters. Report now has it that there were frequent conferences with the result that it was decided as a first step to negotiations on a new basis, that the Twombly plan was to be brought to a head by the discharge of the General Electric committee, which was done, and the public informed by an official statement to the press.

It is said that the bankers then felt that matters would thereafter be in their hands and all General Electric parties evidently were told to "keep hands off" for a channel had been opened that might lead to better terms for General Electric than contemplated by the abandoned plan.

As a result of a lot of work, a plan, probably the one proposed to be presented by Mr. Coffin, was evolved and offered, but it being one-sided it met with no response except a complete cessation of negotiations between bankers.

We have reason to believe that a majority of both boards favor some arrangement concerning patents but that it is likely that nothing will be heard on the subject until the difficulties which have arisen by the negotiations last referred to have been removed.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE SOLAR ELECTRIC COMPANY IN ITS NEW QUARTERS.

ONE of the most important of the changes and consolidations of recent years is that which has now gone into effect merging the separate organizations and business interests of the Brooklyn Electric Manufacturing Co. and the Solar Arc Lamp Co., and making what is undoubtedly a strong new element in the field of electrical industries related to light and power. The new corporation is called the Solar Electric Co. and its personnel includes a number of capitalists and public men, among whom may be mentioned Hewitt Boice, popularly known as the "Blue Stone King," president of the Catskill Railroad and the Kingston, N. Y., National Bank; Andrew Baird, the stone merchant of Brooklyn who was a favorite candidate for the mayoralty of that city last election; Senator Jacob Rice, and Mr. Samuel O'Connor, who has done so large an amount of conduit building. Associated prominently in the new company with these gentlemen are Mr. George A. Mullen, who becomes secretary and treasurer, and Mr. St. Louis Wintner, general manager; Messrs. Boice and Baird being respectively president and vice-president.

The company have given up their works in Brooklyn and have concentrated the offices and factory in the new, fireproof and power Vernon Building, 65 and 67 Duane street, which runs through to 593 and 595 Pearl street. In this way they not only have an opportunity to watch and expedite all work going on, but can consult directly with customers over the work that may be under contract. This factory floor, 175 feet by 60, is supplemented by two large galleries in which smaller detail work is done. Here the company is now busily engaged in the manufacture of a large number of Solar arc lamps, for which several orders are on hand, and in the construction of various switchboards. Within the present year the Brooklyn Electric Manufacturing Co. had already made between 60 and 70 boards, and the record for the year under the new régime is expected to eclipse any made before. One of the boards just finished is intended for the palatial residence of Mr. George Vanderbilt, at Biltmore, N. C., where it will be in operation this winter.

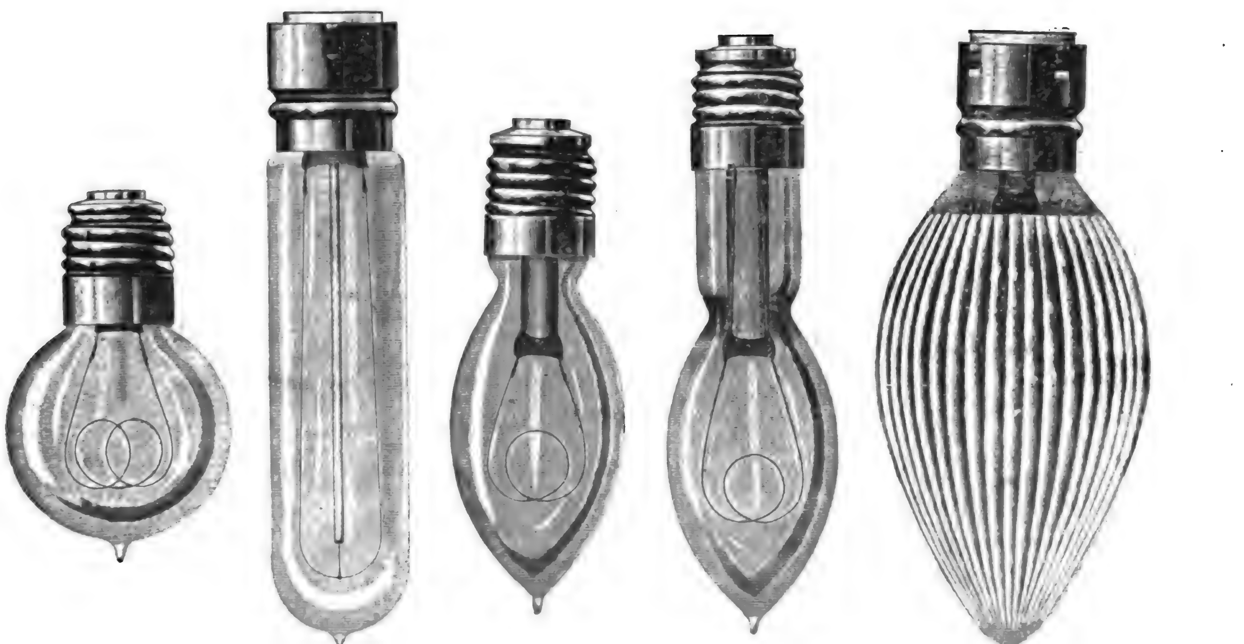
In THE ELECTRICAL ENGINEER of May 29, 1895, Mr. Joseph Sachs gave an excellent illustrated description of the Solar arc lamps, which are based upon the escapement and rack principle, and on the methods adopted for their construction. It will have been noted from that article that the lamp is simple in design and calculated to do good service. Besides switch boards and arc lamps, however, the company make a variety of switches, their specialty being the quick-break; and they are well equipped with tools and machinery for a wide range of first class work. Mr. Wintner gives the business close personal attention, and Mr. Mullen brings to bear on it a ripe experience including that gained with the Morrison Southern Electric Co.; the Brooklyn Electric Manufacturing Co. and other active enterprises.

OHIO BRASS COMPANY.

THE Ohio Brass Company have published a comprehensive catalogue, in which their electric railway supplies, including construction material, line devices and car appliances, are clearly and fully illustrated. They have established a special line of pole tops, arms, and brackets, which are of the best malleable iron, giving the necessary strength for supporting the heavy feeder lines, and the strain of the span and guard wires, with a minimum weight of metal. Their pole brackets, hangers, and general trolley fittings are carefully made, and their supply list includes electric headlights, light fittings, and every requisite for train lighting.

NEW BUCKEYE ORNAMENTAL LAMPS.

ALWAYS on the alert to furnish new designs and improved quality in lamps, the Buckeye Electric Co. are now placing on the market a number of interesting types of ornamental lamps, some of which are illustrated in the accompanying engravings. Fig. 1. shows the "Imperial" lamp made in voltages from 48 to 130 and from 8 to 16 C. P. It is furnished both frosted and plain and dipped blue-green, ruby and amber. Fig. 3 shows the short "candle-flame" lamp, adapted for low voltages and 10 C. P. Fig. 4 is the long "candle-flame" lamp, of the same voltage and C. P. as the short lamp. Fig. 5 shows the "pine apple" type, made for 48 to 130 volts and 8 to 16 C. P.



FIGS. 1, 2, 3, 4 AND 5.—NEW BUCKEYE LAMPS.

We also illustrate the Buckeye "bung-hole" lamp in Fig. 2, which is specially adapted for use in breweries and distilleries for the examination of casks.

VENTILATION IN THE NEW BOSTON PUBLIC LIBRARY.

In our description of the lighting plant in the New Public Library at Boston we were in error in stating that the ventilation was accomplished by a Davidson fan. It should have been stated that the ventilating fan was specially designed by Mr. Frederick Tudor, engineer, and built by Mr. D. P. Gosline of 30 Oliver St., Boston. It is a centrifugal fan with 8 main blades which receive the air from an expanding cone. As the velocity of the air increases, the blade area is increased by supplementary blades of shorter length, thus ensuring a positive delivery of all the air. It is run and controlled at variable speeds by means of a rheostat which is connected with the electric motor.

THE UNION ELECTRIC CO., Manchester, N. H., are making some important additions to their plant. An order was given by them a few days ago for a 500 H. P. vertical cross compound condensing engine to the Ball Engine Co., Erie, Pa.

THE METROPOLITAN ELECTRIC CO.

Any of the many friends or customers of the Metropolitan Electric Co. Chicago, who may visit their fine store on Fifth avenue about this time will find in the activity and bustle to be seen there, that they are among the exceptions to the slackness of trade that is usual at this time of the year.

This is as we all know the season when the fan motor is a boon and blessing to all mankind, and the Metropolitan Electric Co. carry a large stock of fans in all sizes suitable for the office, dwelling or store; for the latter and particularly for restaurants the celebrated Dayton ceiling fan motor cannot be surpassed. It is ornamental in design and handsomely finished and adds greatly to the appearance of any room in which it may be placed. This Company also bought the entire stock of the well known Ries and Scott alternating fan motors, as that Company have retired from business. These fans have a handsome appearance combined with low cost and high efficiency, and intending fan purchasers would do well to send in their orders promptly as the stock is limited and with the present demand must soon be all sold out. The Victor direct current desk fan also combines the above mentioned qualities and is in great demand.

The celebrated P. and B. products for which the Metropolitan Electric Co. are the Western Agents are so well established, and their reputation is so great all over the world, that they need very little comment, and it suffices to say that the Standard Paint Co. are largely increasing their business the older they grow.

The "Mac" Tape which is manufactured by the Metropolitan Electric Co. is first class and is in active demand. The demand also still continues for the Metropolitan incandescent lamps. The Metropolitan Co. have recently placed a large number of the Gilliland telephones of which they are the owners, and when the existing uncertainties of the telephone business are a thing of the past there is every reason to predict that the Gilliland phones will come well to the front.

The attention of the street railway companies of the country may be called to the portable hose bridges which the Metropolitan Company manufacture, and which are being largely used in Detroit and other cities, and have in all cases given the most perfect satisfaction. This invention has been noticed in many of the daily papers all over the country. This device comprises great usefulness combined with simplicity. It can be firmly attached to the rails in a few moments, and in case of fire the hose can be run across the rails and the bridge put in place, so that the traffic will be uninterrupted.

The Metropolitan carry a large stock of wire, lamp cord, lamps, switches, batteries, bells, annunciators, construction tools, push buttons, buzzers, electric gas lighting supplies and all of the many other electrical specialties which are too numerous to mention in these columns.

Their new Catalogue which is now in the printer's hands and will be ready early next month will contain some 600 pages, and will be handsomely bound, and profusely illustrated. The Company have had a very laborious task in its compilement, but they will be well paid for their hard work, as it will be a necessity in every place of business connected with the electrical and street railway fields. Those who are interested in the above lines are requested to send in their orders for copies.

NEW YORK NOTES.

THE ELECTRIC MAINTENANCE CO., of No. 50 Broadway, have appointed The E. G. Bernard Co. of Troy, N. Y., their agents for eastern and central New York, and are about to open a branch office at Philadelphia.

GLEN COVE, N. Y.—The new plant of the Franklin Illuminating Co. has started up. It has a General Electric incandescent dynamo of 1,000 lights, a Ball & Wood engine of 100 H. P. and a Hogan vertical water tube boiler. An arc machine is to be added as soon as possible.

LAWRENCE ELECTRIC CO.—An execution for $6,483 has been received by the Sheriff against the Lawrence Electric Company of 130 Pearl street, New York City, in favor of William Lawrence. The Company was sued in October, 1894, by Hicks Brothers. Mr. Lawrence purchased the claim, and he said the company agreed to pay him, but has not done so. F. H. Mollenhauer has obtained a judgment for $1,041 against the company.

MR. WM. H. PIKE, JR., so long connected with the Brady Manufacturing Company, of Brooklyn, N. Y., and who has been their Superintendent for two years, has resigned, and is now taking a much needed rest. Mr. Oluf Tyberg, M. E., so long and favorably known as a practical and theoretical engineer, and as the designer of many labor saving machines automatic and otherwise, has recently acquired an interest in the Company and accepted the position of superintendent of the factory of that concern at 68 Washington street, Brooklyn, N. Y., where he will be pleased to serve his friends and patrons.

WESTERN NOTES.

THE PARTRIDGE CARBON CO., of Sandusky, O., report an excellent business in their electric railway carbon specialties. They expect soon to be selling to at least 75 per cent. of all the roads in the country, as they are always adding new customers to the old.

MR. H. M. BRINKERHOFF, electrical engineer for the West Side Construction Co., Chicago (known as the Metropolitan Elevated Ry. Co.), has awarded the contract for furnishing a telephone system to the Western Telephone Construction Co., Chicago. This system contemplates about thirty telephone outfits, one at each station, so that communication may be had from point to point.

THE GARDNER ELEVATOR CO. of Detroit, Mich., have received from Donaldson & Meir, architects for Traugott, Schmidt & Sons' eight story building, a contract for three direct electric elevators, two passenger and one freight. Perret motors, Elektron controlling devices and steel construction will be used. This is the third large contract for electric elevators awarded the Gardner Co. in the last two months.

THE ELECTRIC APPLIANCE Company are exhibiting a beautiful line of fancy styles of their Upton Arc lamp which they are now prepared to supply for direct and alternating constant potential circuits, and also for regular series arc work. The fancy lamps are beauties, and everything considered are not expensive. The regular standard Upton lamp is a very business like affair, and on this the Appliance Company claim to be making prices that are decidedly interesting. They have a large stock in Chicago ready for prompt shipments. The Electric Appliance Co. find trade remarkably good and promising to be even better.

CENTRAL ELECTRIC CO.—Although the Central Electric Company have been in the railway business, to fill all kinds of railway orders, but a few months, it is astonishing the number of contracts that have been procured and the promptness with which their orders have been filled. Their overhead material is considered by railway people to be up to date in every respect, and many railway companies are adopting it as their standard. The Billings & Spencer drop-forged overhead material, and thousands of drop-forged commutator bars are being sold. The Central Electric Company carry all of these specialties in stock, and are prepared to make very prompt shipments. They are keeping right up to the times, and are obtaining many new devices of merit that they may supply to their constantly increasing trade the latest, most satisfactory and best of everything required.

NEW ENGLAND NOTES.

BERGER & ROGERS, successors to Berger, Rogers & Potter, engineers and contractors, have removed their office from 620 Exchange Building, Boston, to 255-7 Broadway, Troy, N. Y., where they will attend to electrical work in all its branches.

MR. GEORGE C. EWING has resigned his position as superintendent of the Composite Brake Shoe Co. and has opened an office at 620 Atlantic Avenue, Boston, where he is now handling a line of high grade supplies as the New England agent for a number of prominent houses.

THE W. S. HILL ELECTRIC CO., of Boston, have made an assignment to Mr. Ferdinand A. Wyman, of Boston and Hyde Park. No definite future action has as yet been arranged, but it is the intention of the assignee to carry on the manufacture of the Hill goods for the present, and to endeavor to place the company in a better financial condition than ever before. The Hill Co. have a lot of important work on hand at present in the way of switchboards and switches, amongst which is a large order for the Congressional Library of Washington, D. C., and this will be carried to completion just as usual.

PHILADELPHIA NOTES.

MESSRS. J. W. PARKER & CO., the enterprising agents of the Ball Engine Co., of Erie, Pa., have just delivered to the Camden, (N. J.) Horse R. R. Co., a 400 H. P. Ball vertical cross-compound engine. This is the second engine of this type sold to the company through Messrs. Parker & Co.

THE MERCANTILE TRADE LIST SUPPLY CO., 601 Times Building, Pittsburgh, Pa., makes a specialty of furnishing lists of names and addresses of persons engaged in any trade, profession or special line of work. These lists are incessantly revised, and embrace practically the whole field of industrial pursuits. The company also undertakes to address envelopes, wrappers, &c., and aims to do all its work in a thorough and satisfactory manner. It is noteworthy that these lists are not printed but furnished in manuscript form only.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

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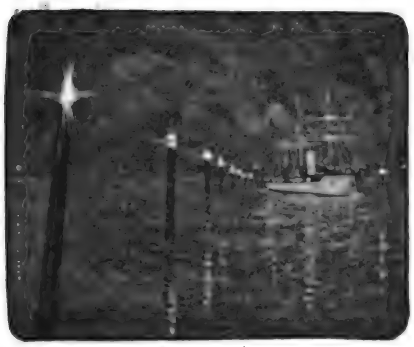
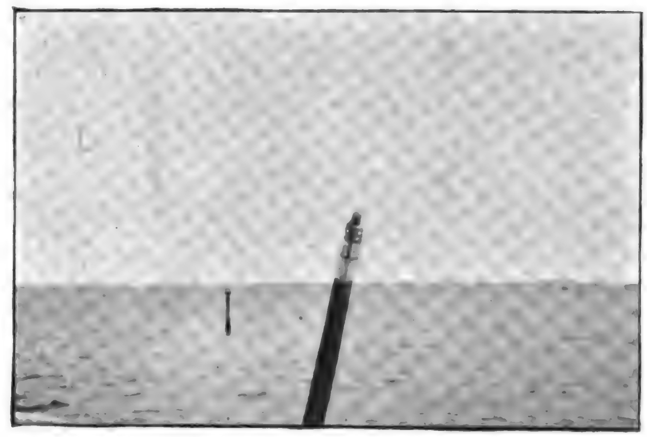
THE USE OF THE ALTERNATING CURRENT FOR LIGHTING GEDNEY'S CHANNEL, NEW YORK HARBOR.



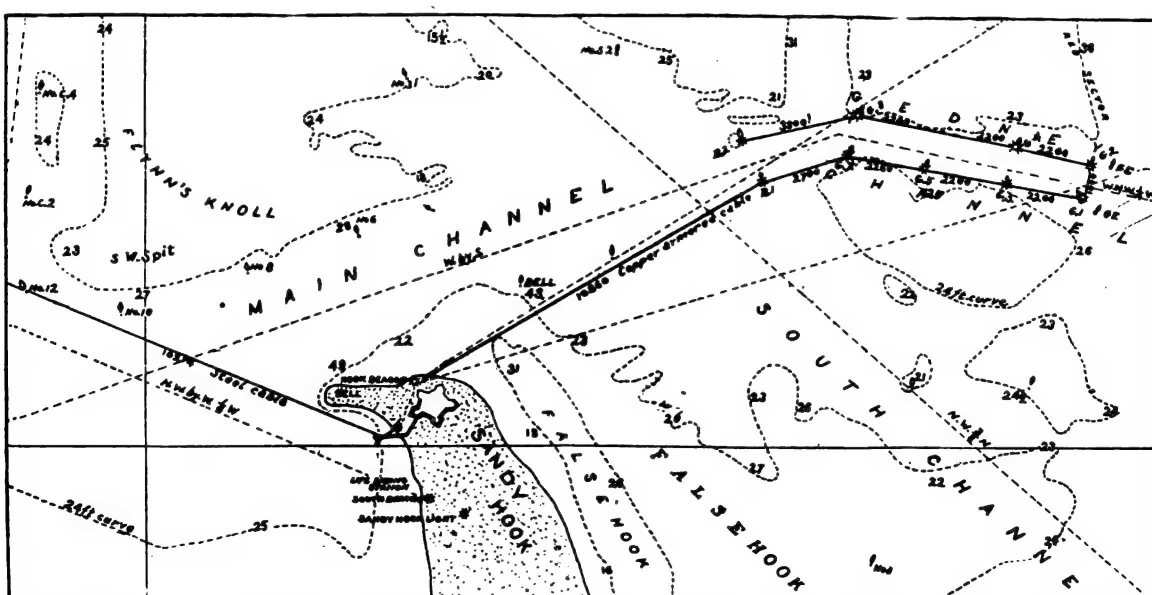
"Coming Up The Lane."

It will be remembered that some years ago, the U. S. Lighthouse Board undertook to light Gedney's Channel, New York Harbor, by means of a series of buoys lighted by electric current from a plant on shore. The work was fully described in the electrical and daily journals at the time, and being so novel, naturally attracted a great deal of attention. The "lane" marks the entrance from the Atlantic Ocean to the Bay within Sandy Hook, and is known as the Gedney Channel and the Southwest Spit. The experimental plant with direct current proved so satisfactory that it has been recently enlarged, the desire of the board being to still further increase the safety of the port. The lighting station is situated almost at the extremity of Sandy Hook. To the equipment formerly used to illuminate the experimental buoys, two 9 K. W. General Electric, multipolar, four pole, alternators have been added. These are arranged with commutator and collecting rings to allow of the delivery of both alternating and continuous current. The alternating apparatus supplies the current for the buoys of the Gedney Channel circuit and the lamp in the Hook beacon ; the continuous current lights the buoy in the Southwest Spit. The alternating



THE NEW ELECTRIC BUOYS, GEDNEY'S CHANNEL.

current employed has a frequency of forty cycles per second, the generator making 1,200 R. P. M. These machines are of the latest type, the fields being of cast steel and the drum armatures being provided with removable coils.



MAP OF GEDNEY'S CHANNEL AND SOUTHWEST SPIT AS LIGHTED BY ELECTRIC BUOYS.

The primary voltage of the Gedney Channel circuit is 1,000 volts, alternating current. At the lamps this voltage can be reduced to 100 volts. The direct current for the operation of the Southwest Spit circuit is 150 volts. Of the two generators mentioned, one is used as a reserve and

each is provided with a 12 kilowatt transformer filled with oil. The switchboard is of white marble arranged for the alternating and direct currents with indicating and controlling devices for their operation; all machinery being in duplicate.

From the dynamo station at Sandy Hook two underground line wires are laid to the landing place of the Gedney cable at the north end of the Hook, and branch wires are laid from it to the lamp in the Hook beacon. Two other wires are laid from the landing place of the cable leading to the Southwest Spit electric buoy. In both these circuits one of the wires is lead covered, with rubber insulation, the other wire is bare. They are laid underground in a substantial boxing of creosoted wood.

ADJUSTING THE BUOY LIGHTS.

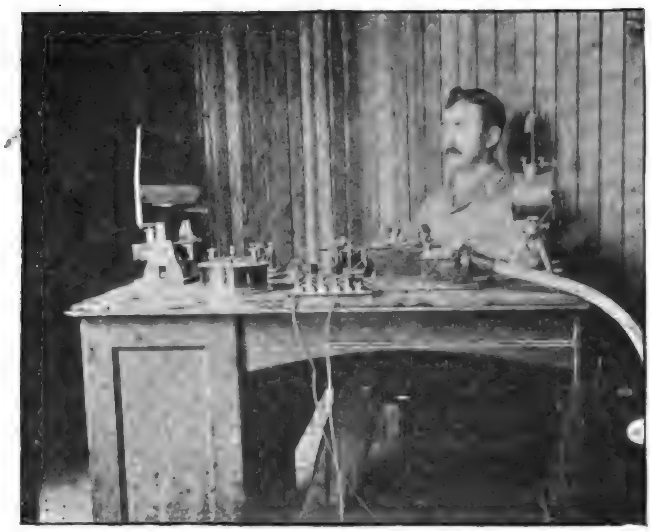
After leaving the land near the Hook Beacon, the cable of the Gedney Channel proceeds as follows:

	Feet.
Hook Beacon to Buoy "B 1"	10,860
Buoy "B 1" to Buoy "G 7"	2,700
Buoy "G 7" to Buoy "G 5"	2,200
Buoy "G 5" to Buoy "G 3"	2,200
Buoy "G 3" to Buoy "G 1"	2,200
Buoy "G 1" to Buoy "G 2"	1,000
Buoy "G 2" to Buoy "G 4"	2,200
Buoy "G 4" to Buoy "G 6"	2,200
Buoy "G 6" to Buoy "G 8"	2,200
Buoy "G 8" to Buoy "B 2"	3,300
Actual cable on Buoys at 100 feet	600
	32,660
	6.18 statute miles.

The length of the subaqueous Bishop cable in use on the Southwest Spit circuit is 10,214 feet; it consists of one conductor of 7 wires of No. 18 B. & S. stranded copper and two armors of steel wire; its weight per statute mile is about 19,113 lbs. The Bishop cable of the Gedney Channel is of the single conductor single armored type; the conductor consisting of 7 No. 18 B. & S. stranded copper wires, the armor of No. 18 B. & S. hard drawn copper wires. The insulation is well seasoned gutta percha and has a resistance of not less than 300 megohms per statute mile. The exterior diameter of this cable is about $\frac{3}{4}$ inch, that of the direct current cable, $1\frac{1}{8}$ inches.

The transformation of the alternating current from 1,000 volts in the primary to 100 volts at the lamp is effected by a small transformer of 600 watts capacity, fitted right inside the head of the wooden buoy. These transformers are mounted in strong watertight cases with heavy oil as an additional insulation, and are mounted inside the buoy without impairing the strength of the head. Of course all openings into the transformers are made securely water tight.

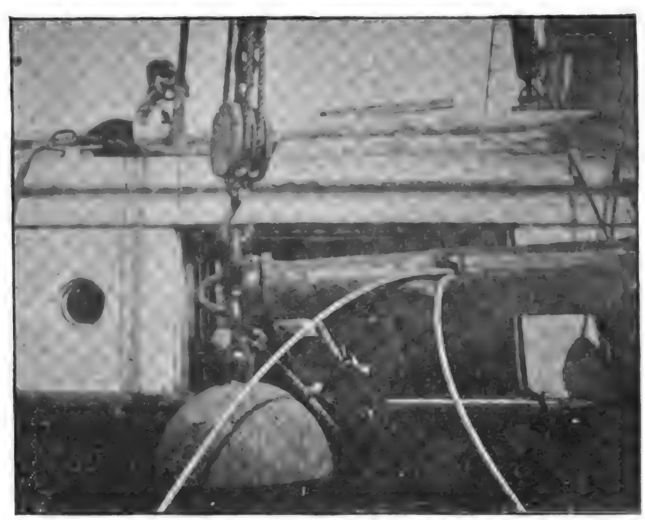
The lamps which are set at the top of each buoy



TESTING THE BUOY LIGHTING CIRCUIT.

—which is a stout pole about 70 feet long anchored by a heavy "mushroom" weight—are covered by a bell glass globe and they are of 100 candle power. The lamp is 5″ in diameter and the filament is spiral. Each lamp takes from $3\frac{1}{2}$ to 4 amperes of current. A lamp of similar size and candle power illuminates the Hook beacon and is so fitted in the lens that it can be removed at any time and another substituted in case of accident. The glass is extremely thick and tough.

Small transformers are used in connection with the



LOWERING SUBMERGED END OF BUOY AND MUSHROOM ANCHOR.

Hook light, similar in character to those used in the wooden buoys. In addition to lighting the channel and the beacon, the current from the alternating generator is also used to furnish light for the keeper's dwelling and the station lamps.

The cable for this work was manufactured by the Bishop Gutta-Percha Company, of New York, and the electrical installation was effected by the General Electric Company, which company furnished the entire electrical apparatus. All the buoys with their attachments, sinkers, lanterns, and lantern guards were supplied by the Government.

The cables were laid by the steamer "Western Union" of the Western Union Telegraph Co., accompanied by the

light house tenders of the Inspector of the third district which laid the buoys and made the connections. After the completion of the work, a certain time had to elapse during which the plant was on probation. The entire plant has now been accepted by the Light House authorities and its acceptance marks the completion of one of the most important works which the Light House Board has undertaken within recent years.

THE BURRY STOCK AND NEWS PRINTING TELEGRAPH.

Although the newer and later applications of electricity to light and power have absorbed the attention of electrical workers it must not be supposed that the older fields are by any means neglected. Indeed the comparative freedom from competition has induced more than one inventor to return to those older fields. Telegraph printers have always had a fascination for telegraphic inventors, and more inventions have been made of late in this branch of the art than perhaps in any other. Our readers will, we know, be interested in the most recent advance in such apparatus, which has gone into practical application, displacing earlier types. Heretofore, "tickers" have as a rule been driven by weights or springs, which have had to be wound by hand from time to time, an expensive and bothersome matter, as the tickers are widely scattered through a city. Attempts, it is true, have been made to wind these springs or weights automatically, but these have met with indifferent success. Electro-motors with reciprocating armatures have been proposed and perhaps used in experimental work. Notwithstanding all this, weights have continued in use as the motive power of the tickers. As is well known, a ticker includes quick-acting escapement-operating electro-magnets, and sluggish "printing" electro-magnets, and it has been proposed to use the latter

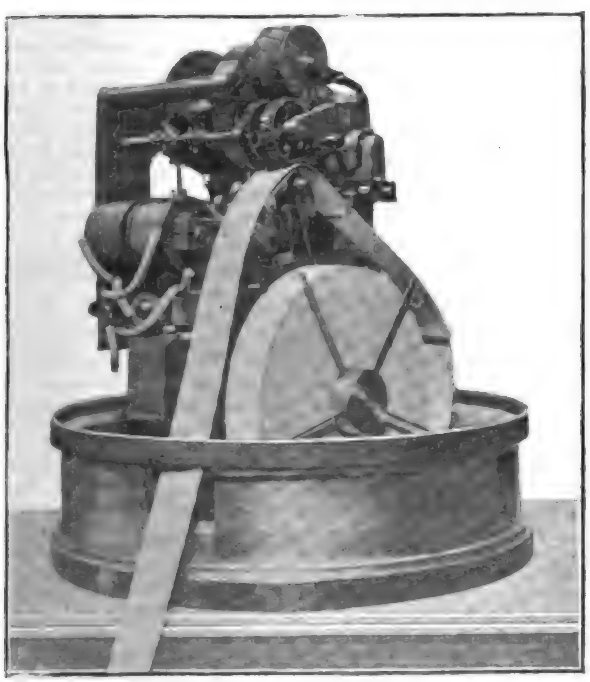
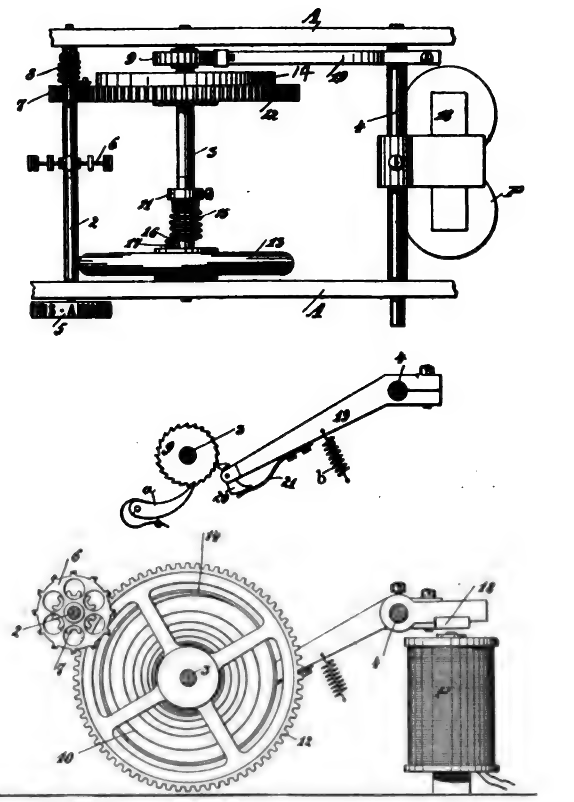


FIG. 1.—THE BURRY SELF-WINDING STOCK PRINTER.

to wind the main spring driving the mechanism of the ticker; but as the time-intervals between "printing impulses" are subject to great variations in practice, it sometimes happens that the main-spring may run down or it may be overwound. Also, difficulties have been encountered in the gearing between the weights and the escapement controlling the type-wheel of the ticker.

After long experiments, Mr. John Burry, electrician of the Stock Quotation Telegraph Co., of New York, has succeeded in completely overcoming all these difficulties and in using the current which operates the printing magnets for winding the mainspring of the ticker, and this without any increase in the strength of the current.

The new printer is shown in perspective in Fig. 1 and



FIGS. 2 AND 3.—THE BURRY SELF-WINDING STOCK PRINTER.

Figs. 2 and 3 show the old square or box-like ticker, as changed by the introduction of the invention in place of the weights and clockwork heretofore employed. In Fig. 2, 3 indicates a shaft to which one end of the mainspring is fast, the spring being within the drum 14, which itself is loose upon the shaft. The spring is not fast to the drum, however, but its outer convolution bears frictionally against it. The numeral 9 indicates a ratchet fast on the shaft 3, the shaft being operated by the pawl-carrying lever 19, which is operated by the "printing magnets" P. The drum 14 is fast to the loose gear wheel 12, which latter meshes with a similar wheel 7, loose on the shaft 2 which carries the type-wheel 5 and escapement wheel 6; spring 8, fast at one end to shaft 2 and at the other to the wheel 7, forms the connection between the wheel and shaft, and avoids the jar and other annoyances heretofore experienced in this part of the mechanism of the ticker.

The principal feature of the printer consists in the fly-wheel 13, loosely mounted upon the shaft 3, and connected therewith by means of the spring 15, fast at one end to the shaft and at the other end to a pin 16 in the hub of the fly-wheel. A stop pin 17 projects from shaft 3 into the path of the pin 16 and acts as a stop.

Whenever a prolonged or "printing" impulse is sent over the line to the magnets P, the lever 19 is operated and quickly turns the ratchet wheel 9 one or two teeth; this winds spring 15 slightly (the inertia of wheel 13 preventing that wheel from moving at once) and moves the pin 17 away from pin 16; spring 15 soon puts wheel 13 in motion and the pin 16 striking against pin 17 of the shaft 3, gives the shaft an additional rotating motion from the energy of the fly-wheel. This latter motion of

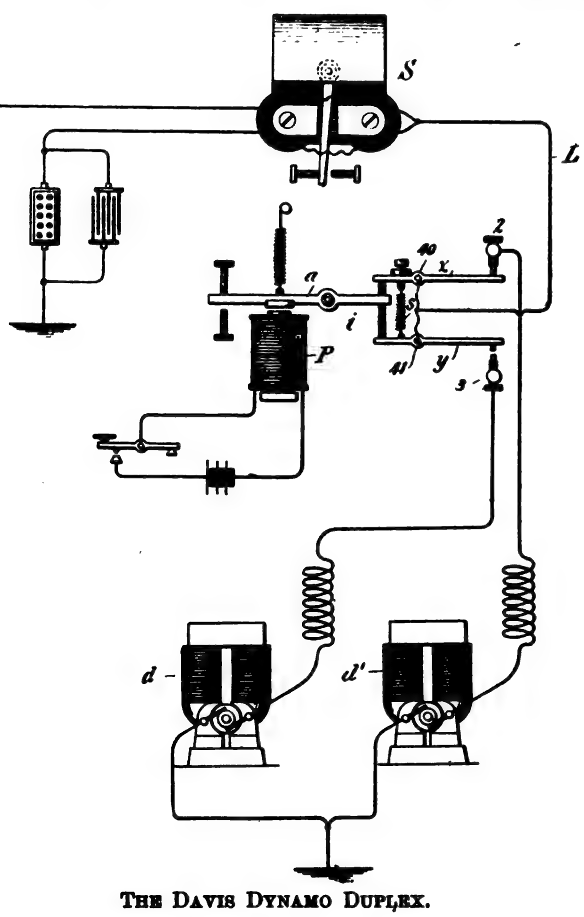
the shaft 3 is generally greater than that communicated to it by the lever 19, and, of course, the winding of the mainspring is also greater in like proportion. The machine is so set that the average tendency is to the overwinding of the mainspring and whenever this occurs the spring simply slips in the box 14. In case the mainspring slips, spring 8 drives the type-wheel. It will be noticed that the remodelled ticker contains comparatively few parts for driving the type-wheel.

It may be added that some 900 of the box-like tickers in New York City have been changed from weights to the above described method of driving them; also over 100 machines of the new model shown in Fig 1 have been built, and a large number are in course of construction.

THE DAVIS DYNAMO DUPLEX AND DIPLEX TELEGRAPH.

In a patent just issued to Mr. Minor M. Davis, assistant electrical engineer of the Postal Telegraph-Cable Co., that gentleman describes a pole changer, for duplex and diplex telegraph circuits, that is particularly useful where dynamo currents are employed. The objects sought were to produce a pole changer that would give clear sound, have elastic contacts, be easy to adjust and clean, be economical of power and be free from troublesome sparking while making rapid changes of polarity.

The accompanying diagram shows the pole changer and



The Davis Dynamo Duplex.

its application to a polar duplex. In the figure, P is a pole-changing transmitter. There are two movable contacts consisting of two unequally pivoted levers x and y, pivoted at 40 and 41, respectively, the location of the fulcrum or pivot being about two-thirds the length of the lever from the fixed electrical contacts 2 and 3. The operating or actuating lever a mechanically connects with the shorter arms of the levers through the medium of the rod of insulating material i. It will be noticed that the length of i is such that when x contacts with 2 and y is separated from 3, the mechanical connecting piece i is slightly separated from x, and vice versa. The two levers x and y are spring retracted, the retracting force being applied to the shorter arms; one spring s is employed with a proper adjusting device to draw the shorter ends of the two levers toward each other. The two levers are shown electrically united, forming the movable terminal of the line, while the fixed contacts 2 and 3 form, respectively, the terminals of two dynamos d and d' of opposite polarity.

LITERATURE.

Die Sekundär-Elemente. Part I. By Dr. Paul Schoop Halle a, S, 1895: Wilhelm Knapp. 210 pp. 5 ½ x 8 ½. Paper.

There are a number of works on storage batteries which give a very fair idea of the state of the art, considered from the standpoint of the construction of the cells, rather than that of the chemical operations which proceed during charge and discharge. Information relating to the latter is scattered through a large number of periodicals, but it would take more time than the average man has at his disposal to gather from this mass what is really useful, and in many cases his inexperience would lead him to the adoption of methods of work, which have not resulted satisfactorily in practice. Dr. Schoop has undertaken the task of collecting what is of value in the domain both of the manufacture of the storage battery and its chemistry and has succeeded most admirably in his undertaking.

The volume before us is devoted to the theory of the lead accumulator and the construction of the Planté cell. A short historical introduction is followed by the theory of the lead accumulator, and the consideration of various stages of oxidation which the lead undergoes in the electrolyte. Special attention is also devoted to what is frequently neglected in storage battery work, namely, the electrolyte. Dr. Schoop devotes two chapters to this important detail, treating of the effects of temperature, electric conductivity, the formation of persulphuric acid, etc. The manufacture of lead accumulators of the Planté type, follows this section, containing a most searching investigation into the action of this type of accumulator, including the various effects noted during the operation of the cell. Among the cells particularly described are those of Pollak, the Oerlikon, the Cheswright. The book closes with a chapter on the employment of Planté storage batteries in central station work. The book is excellently printed and the text is elucidated with accurate drawings and diagrams. The wide experience of the author in this particular field will, through these pages, prove of great value to all engaged in storage battery work, particularly that with the Planté type, which seems to be gradually increasing in popularity, more especially abroad.

WHAT IS SAID OF "THE ELECTRICAL ENGINEER" DATA SHEETS.

Our esteemed contemporary, The Electrical Engineer, deserves our congratulations and best wishes for success with its new departure in the form of Data sheets which appear as a supplement to the paper. Since it takes an enormous amount of time to prepare a note book of your own, and since it is very difficult, at least in a great many cases, to determine under what heading to put a certain statement, table or the like, very few people can afford the time to collect such data as they would like or perhaps almost of necessity must remember. The Electrical Engineer has engaged Mr. Albert B. Herrick to publish data sheets of such size as to make it convenient to carry them in the coat pocket. These sheets are indexed by numbers very closely to the Dewey system of library indexing which is probably the best in the country. In that way a man is saved the trouble of searching where to place a certain notice and also saved the trouble of remembering facts. Professor Helmholtz in a memorable lecture delivered before the University of Heidelberg, stated that he considered those men the most educated who knew where to find things, a statement which he repeated before the students of Columbia College on his visit in 1893. By helping the readers of the paper to "know where to find things," The Electrical Engineer takes the place of an educator, the highest ideal to which journalism can aim. In an editorial the editors say: "The management of the Engineer will greatly appreciate the help of its friends in this novel work, which it believes likely to be of great value and importance to all branches of the profession." We think that this statement might even be turned around, for the readers would be very grateful if The Electrical Engineer will index for them data which they would like to preserve.—*Electric Power.*

ELECTRIC STREET LIGHTING.[1]

BY GEORGE CUTTER.

In considering a question like that of lighting streets, alleys, and public squares, we should first define the results to be produced by the lighting system. It appears to me quite simple to define the theoretically perfect lighting, but it is not as easy to decide which system gives results nearest to the theoretical; local conditions affect this question more or less. A general uniform illumination of mild intensity, such as that of a dark cloudy day or possibly that of a clear night with a full moon is the theoretical condition to be produced by artificial lighting. This is especially the case after bedtime.

There is an illumination better than either of these two for our study to reproduce artificially, and that is a clear night in winter in extreme northern latitudes. That is, the midnight light of the land a little south of the midnight sun. When we can produce this general uniform illumination of mild intensity most desirable in a town gone to sleep we will then have the best night illumination. And the rivalry which has led to the use of brilliant effects with really poor practical illumination will be replaced by attempts to produce the best approach to this theoretical condition, and the glare which blinds a man for half a block with accompanying inability to see for the next half block will become obsolete.

But this mild illumination while it may be best for the outlying or residence districts during all hours of the night, is not sufficient for the business centre during the earlier hours of the evening. So for proper results we must produce a brilliant illumination of this business centre until bedtime, and for the sake of economy we must then change the down town illumination to the same mild intensity that serves for the residence districts earlier in the evening.

There is one important factor in street lighting which might modify our practice in regard to the best general illumination. It is the police duty of the light in preventing crime and in facilitating the capture of criminals. But even for this duty a uniform illumination of mild intensity is likely to prove best because the eye which is adjusted to a bright light cannot distinguish objects in a dull light.

There are various points to be considered when we come to the practical side of the question and try to determine what system will give the best approach to the theoretical results with the fewest practical objections. Among these points I might mention a few of the most important: 1. We should consider the means of distribution to produce the nearest to our theoretical conditions, that is, we should aim to procure a uniformity of light even of mild intensity in preference to a few extra bright spots with intervening dark spots. An exception can be made as before indicated for the business section before bedtime, a brilliant illumination of this section in the early part of the night changing to correspond with the rest of the city for the rest of the night. 2. Reliability of service of the lighting system, since it loses its effectiveness either as a safeguard as a path finder or unless it is perfectly reliable. 3. Steadiness of illumination is another point closely connected in importance to the one just mentioned, and in the same line of thought, viz., that of avoiding contrasts in illumination either in different localities or at different times.

Determining the last two points, brings us to the 4th, necessary skill of all labor and ease of procuring same, the employment of home talent to the greatest extent possible being usually advisable. If the installation and operation of our plant requires special skill, then absence of this skill might cause bad service or even total cessation of light.

Then there is the durability of the apparatus, together with ease and economy of replacing used up parts. In considering this we must look out for both the probability of permanency of the supply of duplicate parts, and the amount of attention to keep all in good working shape. After careful judging of the closely related points thus far enumerated we can well give attention to the 6th: Efficiency of conversion from coal pile to light. My only comment on this point is that I place it second in importance to that of general uniform illumination, as high efficiency can well be set aside for the other more desirable feature of uniformity. Considerations of this point of efficiency lead to the 7th, total operating expenses, the importance of which depends almost entirely upon local conditions, as also the 8th point, cost of necessary plant for producing the light.

This leads to the 9th: appearance of fixtures on streets and squares and on this point more attention should be given than is the usual practice. A large share of the opposition to overhead wiring would never have been raised if it had not been for the bungling work which is so common.

The Chicago & Northern Pacific R. R. has already begun work on the equipment of its Chicago suburban lines by electricity. It expects to have electrical trains running in about three months.

1. Abstract of a paper read before the Northwestern Electrical Association, Chicago, July 17-19, 1895.

PERSONAL.

HARRY BARRINGER COX.

Harry Barringer Cox.

Few advances have attracted so much attention of late as the work of Mr. H. B. Cox in the direct conversion of heat into electricity and in the improvement of thermopiles. As a matter of fact, Mr. Cox though coming forward at a single bound into widespread publicity is no novice, but has been a hard worker in electrical investigation for many years. He was born at Zanesville, O., in 1863, being a direct descendant of the Long Islander, Gen. James Cox, who was on Washington's staff, and a cousin of the late Hon. S. S. Cox, whose statue was recently set up in this city by the postmen as a tribute to his brilliant advocacy of their rights, in Congress. Young Cox was educated in the public schools of Cincinnati but when only 14 years of age struck out for himself by becoming a telegraph messenger in the P. C. and St. L. Railway office, where he at once learnt telegraphy and developed an insatiable interest in electricity. He continued in railway work, chiefly on the Cincinnati Southern until he was twenty-two, when he entered the service of the Cincinnati Electrical Co. as its electrician, a post for which close private study and attendance at the School of Design had abundantly fitted him. His first electrical invention was a railway train signal which was adopted on several lines but was at last superseded by the Westinghouse pneumatic whistle signal. He next invented the Gelatine Battery, which was the first semi-solid cell to be extensively used, and of which large numbers were made and sold. About this time he built a small private laboratory at Fernbank, O., a suburb of Cincinnati, and there began his investigations upon the direct conversion of heat into electricity.

Mr. Cox was called to Europe in the spring of 1888 by the German Government for some special work, and upon his return he settled in the East, devoting himself during the fall and winter to experiments on the New England coast, on sound, in relation to marine signaling. The results of this work were five papers read before the International Marine Conference at Washington. The Light House Board also published in its annual report a complete digest of Mr. Cox's work on this subject.

These experiments may, perhaps, be regarded in the light of a diversion, for they were no sooner closed than Mr. Cox at once resumed direct conversion work, his studies in which field have really been most exhaustive, altogether aside from active investigation in his laboratory at New Haven. He has a most complete library bearing on the subject, including not only every book but every patent; while the most voluminous record of all would probably be found to consist in his own researches which have been tireless and numberless. The first and only account that has been given to the public was prepared by Mr. Cox himself for The Electrical Engineer, and appeared in its issue of May 1, when the apparatus was very fully illustrated and described. Since that time Mr. Cox has had to go to Europe on business connected with his inventions, and in a recent letter from Paris he wrote to this journal: "The subject of the direct conversion of heat must interest the public for I have, as a result of my descriptive article in your paper, received over 900 letters of inquiry, many of them coming from the furthermost parts of the civilized world." Mr. Cox's work has, indeed, been of the kind to encourage new hope as to the early practical fruition of efforts in the domain of direct conversion; and every electrician entertains the wish that Mr. Cox may be successful in the important lines of work he has marked out and along which he has already gone so far.

The Walkill Valley Electric Light Co., of Walden, N. Y., intends to increase its plant by adding an incandescent light dynamo, an arc system, and a 100 H. P. engine. Address, A. J. Fowler.

ELECTRIC TRANSPORTATION DEPARTMENT.

A RIDE ON THE NANTASKET ELECTRIC RAILROAD.—A NEW ERA IN SUBURBAN TRANSPORTATION.

BY J. B. BAKER.

A ride on the railroad running from Pemberton to Nantasket and sharing with the Boston harbor steamboats the traffic to the latter popular beach resort, is a novel and exceedingly interesting experience, now that the road has been equipped for electric motive power. I got on one of the open cars the other night for the ride to Pemberton, one of a large crowd getting on at Nantasket, and occupying every available inch of space in the seats of the three or four cars making up the train. Many others, late comers, wished to stand on the top running board which lines the sides of the cars, but were peremptorily ordered off by the conductor.

The cars bear a resemblance to the "open" variety of street cars in respect of having seats running all the way across, and being quite open at the sides; but here the resemblance stops. For they are almost as long and fully as wide as "steam cars," and the three steps running along the whole length of the car bring the height of the passenger from the ground fully equal to that of the seat in an ordinary railroad train. The cars are well lighted, by incandescent lamps, of course, and are attached in a train of three or four to the locomotive. Here there is a distinct retrograde movement, in an artistic sense, I think, from the steam locomotive—at least the handsome American one, with its delicate and powerful mechanism in plain sight—resembling what might be called a cross between a "dummy engine" and a baggage car. Only the headlight, carried low in front like those on the street cars, and the trolley pole slanting up from the roof, showed it to be really the locomotive of a true "broomstick train"—the very latest edition of the iron horse.

When all the passengers were seated, and the conductor had assured himself that no one was standing up outside, the "all aboard" signal was given, and we started up. And now one of the most striking differences between this train and one on a steam road was shown. Without an actual jerk enough to be disagreeable, yet the start was a remarkably quick one; the sensation imparted to the passenger as the motorman turned on "the juice" was one of great exhilaration at the quick attainment of speed. Moreover, one could feel an instantaneous and marked acceleration each time he turned through an additional notch in the controller. This was to some extent no doubt due to the lightness of the cars compared with steam cars of the same capacity; but principally to the more direct pull of the electrically driven locomotive over the necessarily jerky and irregular traction of the steam engine.

In a very few moments we were running along the shore at a rate of speed which it would be hard for any of our Boston suburban trains to equal. The reason why passengers are not allowed to stand outside now became apparent. With the trolley poles flashing by at the rate of 35 miles an hour or more one would need to have a cool head and a good firm hold to keep from being thrown off on going around some of the curves. As it was, one felt like holding on to something although securely seated; and the occasional greenish flashes from trolley wire or rails, with the clanging of the gong—for all the world like that on a patrol wagon in sound and look—helped to make the sensation an exciting one. Once in a while the whistle was blown—by compressed air—and its note was free from the hoarse, discordant quality of the steam whistle.

The trip to Pemberton includes numerous stops, which prevent any sustained high speed; yet no one who has ridden in this up-to-date train can fail to perceive that the electric locomotive gets its train up to speed quicker and apparently easier than a steam locomotive can. The stops, too, are made quicker, as the air brake which is used brings the light cars to a standstill with no jerk or grinding, yet very positively and quickly.

As a whole, the experience is a most enjoyable one, and the impression is gained that this experiment in suburban passenger traffic under extraordinarily severe conditions is to be a signal success, and is to mark the beginning of a new era in railroading.

TROLLEY COMPETITION WITH THE LONG ISLAND RAILROAD.

The active competition of the trolley road that runs from Long Island City to Flushing has caused the Long Island Railroad to announce a reduction of fares on their north shore division that runs to the same villages as the trolley. The reduction is the second since the trolley road was opened.

ADOPTION OF ELECTRICITY ON THE PENNSYLVANIA'S MT. HOLLY STEAM BRANCH ROAD.

With regard to the supercession of steam on the Mt. Holly-Burlington Branch of the Pennsylvania Railroad, the *Philadelphia Record* of July 28 has the following article descriptive of the inauguration of the electric trolley service furnished by the Westinghouse Electric Co. :—

The new trolley line of the Pennsylvania Railroad between Burlington and Mount Holly was formally opened to the public yesterday, and scored an instant success, not only in mechanical operation and speed, but also in the patronage it received and the reduction in fares made possible. As a steam road the line has never paid, and for this reason it was selected by the railroad company as a promising field for experiments as to the advisability of supplanting steam by electricity. If these prove as successful as expected, it is believed that the same change of motor power will be made on many other short branches of the "Pennsy."

Only one trolley car was run between Mount Holly and East Burlington yesterday, and upon nearly every trip it was well filled. It ran over the road very smoothly and rapidly, the schedule time between the two points being 20 minutes for the seven miles, a reduction of five minutes from the old steam schedule. With the introduction of the trolley the company increased the service between the two towns, and also reduced the fare—two moves that are highly appreciated by the people of that section. The new schedule calls for 10 trains each way weekdays, instead of six under the old schedule, and nine on Sundays, instead of one, as formerly. Under the present schedule one train each way is propelled by steam, and runs between Mt. Holly and Burlington. The other nine trips are by trolley, and the cars run only to East Burlington.

Even more interesting to the public than this increase in service is the radical reduction in passenger fares. The new rate, which is standard between Mount Holly and East Burlington and all intermediate points, is 10 cents. To Burlington the fare is 15 cents, as against the old rate of 10 cents and 18 cents to intermediate points, and 24 cents to Burlington. All single tickets east or west of Mount Holly and Burlington have been reduced 14 cents and excursion tickets, 20 cents.

A good idea of the popularity of the new road can be formed from the figures of the station agent at Mount Holly. Up to 5 o'clock yesterday, he reported the sale of 68 tickets, of which 11 were to Burlington and the other 57 to East Burlington and intermediate points. Besides the sale of these tickets the receipts by the conductor for duplex tickets up to the same hour were $10. These figures may seem small to the ordinary observer, but, compared with the passengers carried before the change went into effect, they represent an increase of fully 300 per cent.

The officials of the company at Mount Holly, who watched the operation of the new line very closely yesterday, expressed the belief that the rush of travel was not spasmodic and prompted only by curiosity, but that it had come to stay and would gradually increase. The reduced fares, they argued, would tempt people who heretofore have transacted their business between Mount Holly and Burlington by letter to use the trolley and transact it in person.

Already there are symptoms of trolleyosis in Mount Holly, and trolley parties are talked of. The Christian Endeavor Society of Mount Holly, will, it is understood, take the initiative and go to Burlington on Friday evening by trolley.

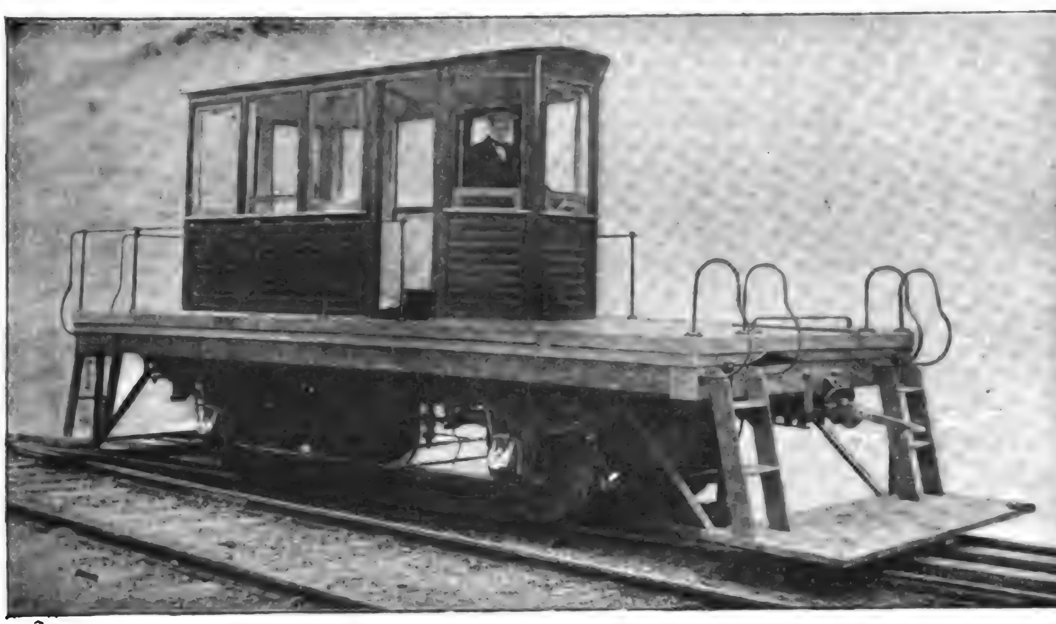
While Mount Holly and points along the road are enthusiastic over the advent of the trolley, the people of Burlinton don't join in the enthusiasm. Indeed, they are very much incensed at the action of the Pennsylvania Railroad in running trains through their city without stopping, a change which came with the advent of the trolley and reduced fares. When the company began to trolley the Burlington and Mount Holly branch it was the intention to build the line to the main station in Burlington. The authorities of that city, however, refused the application of the company to put down an additional track upon which to run their trolley cars, and they were then compelled to make East Burlington the terminus of the trolley line. As a retaliatory measure the company yesterday changed the schedule on its Amboy division so as to run all passenger express trains through Burlington without stopping. A stop is made, instead, at East Burlington, where passengers from the Burlington and Mount Holly branch will make connections for points on the Amboy division.

The electrical plant which operates the new trolley lines is located at Mt. Holly, a short distance below the station. The building is supplied with a 300 horse-power boiler and a 300 horse-power Westinghouse compound engine and generator.

WHELESS MOTOR CAR IN THE WESTINGHOUSE YARDS, EAST PITTSBURGH.

We have already illustrated at various times the Wheless electric railway system now owned by the Westinghouse Electric & Mfg. Co., in which current is taken up by means of pins and shoes in the roadbed, operated electro magnetically by the passage of the car.

A line on this system has been in use for some time at the yards of the Westinghouse Electric and Manufacturing Co., at East Pittsburgh. The accompanying engraving, from the *Railroad Gazette* shows one of the motor cars used on this line. It is used for switching loaded cars in and out of the buildings, it being undesirable to use steam locomotives, on account of smoke and cinders. The motor will haul several cars as easily as a steam switcher. It has two 50-H. P. motors, one on each axle, and the floor is covered with about 8 in. of cast iron to give the necessary adhesion. This system has also been installed upon a branch of the Eckington and Soldiers' Home Railroad, about one mile in length, situated upon North Capitol street, beyond New York avenue, Washington, D. C., the system, however, differing from that which we have just described, in that the boxes are placed between the rails, instead of to one side, and short sections of flat conductor are used, instead of the pins. This line has been in operation during the past winter, and traffic upon it was not interrupted at any time by snow or ice. The contact shoes, while not rigidly supported, are sufficiently stiff to scrape off any ice which may form upon the track terminals, and should contact not take place at any one pin, which, however, is not at all likely, the momentum of the car would carry it over to the next pair. This line costs about $35,000 per mile of double track.



WHELESS CAR IN THE WESTINGHOUSE FACTORY YARD.

THE RELATIVE ECONOMY OF ELECTRICITY AND CABLE.

In a recent interview on the use of the trolley in Chicago, Mr. M. K. Bowen, superintendent of the City Railway Co. of Chicago said: "Electricity is a complete success as a motive power for surface roads under certain conditions. There is no probability that the cable will ever be replaced with electric cars, at least so long as the electric system is anything like it is at present. When there is sufficient traffic to justify twelve cars to the mile of double track the cable becomes the cheapest form of traction per car mile run, and electricity cannot compete with it. On the other hand, when the traffic is not sufficient to justify more than four cars to the mile of double track, horses become the cheapest form of motive power. With traffic anywhere between these two extremes electricity is the most desirable. The space in a barn taken up by a street car is 300 square feet. The space occupied by horses to run that car is 800 square feet. The change to electricity gives the railroads two-thirds more barn room. The limit of the capacity of cable lines is reached when a rear train is compelled to stop for a train in front of it, when the first train stops to take on or let off passengers. We came just about up to that limit in 1893, when we ran trains with fifty seconds' headway. With Clark street equipped electrically, taking care of the traffic of the cross-town lines, the congestion on the cable roads will be greatly relieved and there will be no danger of reaching the limit of their capacity for some years to come." This dividing line between cable and electricity might possibly disappear, we think, with a conduit system. The relative economy, it will be remembered, was stated by Mr. McCulloch, of St. Louis, in the remark that when a road earns $50 a day per mile of single track, it is more economical to operate by electricity; but when the amount reaches $100 a day, the cable is cheaper.

ARRANGEMENTS FOR EXHIBITION AT THE MONTREAL MEETING.

The executive committee of the American Street Railway Association announce that the Victoria Rink in Montreal has been secured for the street railway exhibition to be held in connection with the convention beginning Oct. 15. It is near the Windsor Hotel, the headquarters of the association. Supply companies proposing to make exhibits are requested to apply to Stonewall Jackson, local secretary, 17 St. Sacrament street, Montreal, Quebec. The executive committee have made an arrangement with M. Davis, customs broker of Montreal, for a reduction in custom house charges on goods to be exhibited, as follows: Warehouse and bond entry, $1; export bond entry, $1; making and procuring consular certificates, $1. When goods to be returned are valued at $50 or more, a consular certificate which costs $2.50 must be procured, but this is unnecessary in the case of goods which are valued at less than $50. Shippers should mark goods with their own name, and "Care of M. Davis, Montreal, for exhibition purposes," prepaying the freight, and sending invoices marked "certified correct," and signed. On arrival, Mr. Davis will make warehouse bond entry, and have goods delivered at the Victoria Rink.

When the exhibition is over, the owners of the goods will have to re-pack them, using preferably the original cases. It is a distinct advantage to have them in the same cases, so that the marks may be identified. Consignors must pay all freight and cartage.

Space will be allotted on August 1 to all exhibitors whose applications have been filed with the secretary and accepted on or before that date. Applications for space received and accepted after August 1 will be allotted remaining space, if any, in the order of their acceptance. The space will be charged for at the rate of 15 cents a square foot, and no space less than 50 square feet will be rented, nor more than 1,000 square feet unless by special arrangement with the secretary.

CLEVELAND'S TROLLEY BILLBOARDS.

THE Cleveland street railway companies have gone into the advertising business in a novel way, by building billboard cars, constructed with the purpose of showing the greatest amount of poster space, and these are kept running over the various city streets. The citizens would prefer to have the companies put on more cars for carrying passengers instead of crowding the streets with the trolley billboards.

HARTFORD TO NEW BRITAIN, CONN.

The company which is to connect Hartford with New Britain by trolley is the Newington Tramway Company. F. G. Breed, the President, is also superintendent of the General Railway and Electric Company of New Britain. The road will be built under a charter granted in 1893, which would have expired on June 29. On June 28 the company was organized and accepted its charter. It is claimed that the new road will not parallel either the New York and New England or the Consolidated Road. It is expected to have the road built by next Spring.

REPORTS ABOUT THE CHICAGO AND ST. LOUIS ELECTRIC.

The Chicago & St. Louis Electric Railroad, which started with a big hurrah three years ago, has collapsed, says the New York *Morning Journal*. There is a "To Let" sign on the company's offices in the Women's Temple, Chicago, and sundry creditors are seeking for some one who will pay them. The only address of the defunct company is now care of the general delivery, St. Louis, Mo. Rose-colored were the opening prospects. An air line between Chicago and St. Louis, electric trains running 100 miles an hour, yearly earnings of $2,895,000, and a 29 per cent. dividend were, among other things, mentioned.

A LONG ROAD FOR RICHFIELD SPRINGS, N. Y.

The Little Falls and Richfield Springs Railway and the Richfield Springs and Schuyler Lake Railway, the former to operate an electric street road, 18 miles long, from Little Falls to Richfield Springs, and the latter one a mile long, from Richfield Springs to Schuyler Lake, in the town of Richfield, Otsego County, have been incorporated. The Little Falls and Richfield Springs Railway has a capital of $200,000, and the Richfield Springs and Schuyler Lake Railway a capital of $20,000. The Boards of Directors of the two companies are identical, comprising Caleb L. B. Tylee, Frank H. Viele, George E. Tylee, Edwin J. Carpenter, John L. Miller, and Thomas J. Mack of Corning; Theodore C. Bates and William H. Tylee of Worcester, Mass., and H. Arthur Sillsbee New Bedford, Mass.

THE PHILADELPHIA FENDER ORDINANCE DEFECTIVE.

City Magistrate Jermon, of Philadelphia, has decided that the trolley fender ordinance is defective; and hence the city loses all the multitudinous suits it has been piling up against the local street car companies for non-compliance with it.

NANTASKET BEACH TROLLEY VERY SATISFACTORY.

Judge John M. Hall, vice-president of the New York, New Haven & Hartford railroad company when asked last week if the Nantasket branch of the Old Colony line, the first established steam road in this country to be devoted to electricity in both its freight and passenger service, was running satisfactorily under the new arrangements, he answered: "Thus far the results have been very satisfactory. We are now awaiting statistics from the Nantasket branch which will determine with more accuracy whether the electrical equipment has proved the thorough success which has been claimed since the branch was started. One thing is certain that the trains have run well under excessive excursion demands and at a high rate of speed. It is safe to say that if the experiment of equipping the road proves entirely successful, other branches of the Consolidated Road will be changed from steam to electricity in a very short time."

CONSOLIDATING PHILADELPHIA ROADS.

The plan to unite the Philadelphia, People's and Electric Traction Companies was completed last week. The plan provides for the amalgamation of the People's and Electric Companies, the consolidated concern then to lease the Philadelphia Traction Co. at 4 p. c. on a par of $100, which is equivalent to an annual dividend of 8. p. c. on the company's capital stock. The new company will have a capital of $30,000,000, and the shares will have a par value of $50 each, making 600,000 shares. The shares will be held at the disposal of the different companies thus: Philadelphia, 310,000; People's 155,000; Electric, 135,000. J. L. Welsh, president of the People's Traction Co., and also one of the receivers of the Reading R. R., will be the president of the new company. The new concern will issue bonds to the extent of $15,000,000.

Long Island.—A trolley road is proposed for the eastern end of Long Island from Orient to Riverhead, and the consents of property holders are already being secured through all the towns en route.

ELECTRICAL PREPARATIONS FOR THE ATLANTA EXPOSITION.

In our last issue we gave a number of details with regard to the preparations being made by electrical concerns for the Atlanta Exposition; and showed also the exterior of the finished building. We are now able to publish a cut of the interior, from a photograph taken for us last week; from which it will be seen that the building is ready for the reception of exhibits. The General Electric Co. is already on the ground with a large shipment and is energetically getting ready. Applications for space in the Electricity Building are still being received. Assignments have been made in the last few days to the Clark Electric Specialty Manufacturing Company, of Minneapolis, Minn., and also to the Post-Glover Electric Company, of Cincinnati, Ohio. The former will exhibit push buttons, battery boxes, bell boxes, transmitter boxes,

Interior of Electricity Building, Atlanta Exposition.

electric mouldings, and all woodwork pertaining to electrical work.

The Post-Glover Electric Company will exhibit electric light and electric railway supplies and fixtures.

A very interesting part of the exhibit to be made by the Department of Household Economics of the Woman's Board, at the Cotton States and International Exposition, will be cooking by electricity. Electric stoves will be shown in operation, and the process fully explained.

The Safety Insulated Wire & Cable Co. of New York has received the order for the underground cables for the 125 arc lights.

Letters to the Editor.

PROF. GEORGE FORBES ON PROF. ROWLAND'S LETTER.

With regard to the letter of Prof. H. A. Rowland, published in The Electrical Engineer of July 3, Prof. George Forbes has given out the following reply:

The above letter requires refutation on two points—(1) that Prof. Rowland had anything to do with the plans adopted for Niagara, (2) that the extract from one of my confidential reports is the specification which I sent out to manufacturers to bid upon.

I.—Prof. Rowland's Claims.

1. The officials of the Niagara Company have informed me and others that he was employed only to get him to withdraw his opposition to alternating current. To do this they gave him one (and only one) of my reports to them which dealt with this point, and they got me and others to instruct him. At our first meeting he stated *ex cathedra* that the Tesla motor was of no use; but cross-examination proved that he did not understand the principle of its action Seven months of instruction reversed this decision.

2. So useless was his report to the company that it was not shown to me until I had completed all my plans and decided on the dynamo design.

3. His report did nothing except to recommend the dynamo proposed by a certain firm, to whom, at the same time, he was trying to sell some patents for transformers. This dynamo was totally unsuitable.

4. His pitiable lawsuit showed, by the evidence of the com-

pany's officials, that he had nothing to do with the plans for our work, and that the directors relied entirely upon the advice and inventive capacity of their electrical consulting engineer.

II.—My Specification for a Dynamo.

1. *The quotation in Prof. Rowland's letter is not the specification I sent to manufacturers.* This accounts for much of his misunderstanding. That specification filled twelve pages of printed foolscap, was accompanied by twelve sheets of drawings, and was never shown to Prof. Rowland. My paper in 1893 to the I. E. E. contains an abstract.

2. The report of thirty-six pages which he read says at the end that it is *not* a final report; but it is a very good general account of the plans we have adopted. It is absurd to say I opposed what we have done. As the consulting engineer, I originated it and carried it all through.

3. What he quotes as my specification was a suggestion I made when a separate fly-wheel was thought necessary, as this was the only type (like the Siemens or Ferranti) which could possibly bring the weight down to what we were absolutely limited to, and if it could be made strong enough it was the best type electrically. That suggestion of a specification was guarded by the prefatory words, "*if* a thoroughly good machine, electrically and mechanically, can be designed on these principles, it ought to comply with the following specification." From designs I worked at it seemed possible, but I was not over sanguine, and I had not then hit upon the novel design of alternator with external revolving field, which did away with the necessity for a fly-wheel, which completely solved the problem, of which I sent out specifications which I caused to be constructed, which was described and illustrated in my paper to the I. E. E., about which Mr. Knapp in the discussion said it was the best possible design for the purpose, and for which the Company formally thanked me in writing as having saved them from a most awkward dilemma. I could not, however, with this design use so low a frequency as I desired.

I could say a great deal more, but do not wish to take up more of your valuable space. I wish it to be known, however, that Prof. Rowland's misconceptions are largely due to the fact that we did not think it necessary or advisable to inform him of what we were doing.

George Forbes.

34 Great George Street, Westminster, 9th July, 1895.

MAGNETO-ELECTRIC SPEED RECORDERS.

In reading an account of the machinery on that magnificent American liner "St. Louis" I feel flattered to notice she is equipped with magneto-electric speed indicators constructed on the line of my invention "Recorders of Speed of Driven Shafts" which was described in The Electrical Engineer nearly two years ago.

The instrument differs from the ordinary counters used on ships as it shows at a glance the speed of the shafts *in turns per minute* or miles per hour, the indications being located at different points on the ship. I would suggest to marine engineers that a very desirable improvement is within easy reach, by adding the recording apparatus shown in my patent and driving the paper strip by clock work instead of by the motor shown; or using the entire mechanism shown and adding a supplementary pencil to be driven back and forward across the recording paper every half hour. This would leave a perfect log of the engineer's movements, showing the speed of the screw, back or forward, standing or racing at any second of the trip.

J. C. Henry.

Colorado Springs.

INDEPENDENT EXCITATION FOR TURBINE DRIVEN GENERATORS.

I have read with great interest an article in your issue of July 17, 1895, entitled: "Steady Voltage for Turbine Driven Railway Generators.—The Ahearn Method." The method is very good, but it seems to me that you would have hesitated in calling it "The Ahearn Method" if you should have happened to remember the following paragraph from my paper: "Practical Notes on the Electrolytic Refining of Copper," read before the American Institute of Electrical Engineers, June 6, 1892:—

"A few words as to electric generators may not be out of place. The author prefers separately excited machines for the reason that they cannot be reversed and other incidental advantages. When water power is used as a prime mover a good deal of trouble has been experienced in the regulation of the wheels. As a matter of fact, there is no water governor in existence which will regulate so perfectly as the governor of a modern automatic engine under varying loads. By running all the exciters from an independent prime mover (either water or steam) the strength of the fields of the generators will be uniform at all times whether there are fluctuations in the external circuit or not; the strength of the field of the generators which, with self-exciting machines, is subject to the fluctuations in the external circuit, and is a variable, becomes a constant. The author proposed this arrangement over three years ago for railway and power stations with the very best results."

It will readily be seen that what you please to term "The Ahearn Method" was suggested and tried by me as early as 1889. At the time I first suggested this method, I discussed with my patent attorney the question, whether it was a patentable invention or not and he stated most positively that it was not. I simply mention this as a matter of record.

You will greatly oblige me by publishing this communication in the next issue of your paper.

F. B. Badt.

Chicago, Ill., July 22, 1895.

APPRECIATION OF THE "DATA SHEETS" IN NOVA SCOTIA.

The second of your "Data Sheets" is to hand and I am very much pleased with it. To use the historic remark of King Henry VIII. "You have got the right sow by the ear." The local telephone manager was trying to decide what paper to subscribe to, but on seeing your first Data Sheet, it settled the question, and I sent his name to my news agent along with an order for a morocco case for each of us. You will please add my name to the list of those willing to give a helping hand. I am collecting some data on "Illumination," that is to say the effect of various ways of lighting stores, halls, churches, etc. Any of this you are welcome to. It is gathered from and applies principally to the class of work met with in the medium and smaller sized plants, but my experience is that those in charge of these plants throughout the country are more in need of "data" and "wrinkles" than those in the large cities. I would suggest that as soon as practicable you publish an expansion of the general classification, as there are probably many like myself who would like to index their own notes under the same system. I have been using the card catalogue method of keeping notes and have now cut out of the sheet in the advertisement, page XV, of your current number, (July 17) and attached it to my card box as an index for them, and shall number the cards to match. I have also some notes on the material, time and labor required in reconstructing pole lines. Let me know if any of the above data will be of service to you and when you will want it. Wishing you all success in this venture.

Fred. A. Bowman.

New Glasgow, N. S., July 22, 1895.

ELECTRIC LIGHT AND TROLLEY WIRES AS LIGHTNING PROTECTORS.

It is a singular and interesting fact that during the present summer, while severe lightning storms have been of frequent occurrence in all directions, and within 10 or 15 miles of this city, yet the city itself has been remarkably free from electrical disturbances, so much so that, up to this time, not a fuse has been blown nor an arrester plate grounded by lightning in our switch this season.

During the summer of 1894 this city was also remarkably free from severe lightning. In this respect the summer of 1894, and more especially that of the present year, are in marked contrast to previous years, when the blowing of fuses and burning of instruments were of frequent occurrence. The inquiry suggests itself whether the extension of heavy trolley and light currents in all directions through the city during the last two years is not responsible for this immunity from severe lightning storms?

D. B. Grandy,
Postal Telegraph Co.

St. Louis, Mo.

[The observations of our correspondent are in accord with previous experience under like conditions. There can be little doubt that the network of overhead wires within cities acts as a protection against lightning to a considerable extent.—Eds. E. E.]

PRAISE FOR "THE ELECTRICAL ENGINEER" DATA SHEETS.

Mr. Horatio A. Foster writes us: "Please let me congratulate you on the new Data idea. It strikes me as being better than any pocket book idea, mainly because it may be always kept up to date." Dr. Louis Duncan, of Johns Hopkins University, writes: "The Data Sheets are fine." Mr. P. B. Delany says: "The Data Sheets are a happy thought, and cannot fail to nail the old and hook new patrons of the "Engineer." Mr. A. E. Braddell, the insurance electrical expert of Philadelphia, orders a filing case and writes: "Congratulate you; great brain to evolve the idea."

TELEPHONY.

THE EASTERN ELECTRIC CO.'S TELEPHONE SWITCHBOARD AND OTHER EXCHANGE APPARATUS.

NEXT in importance to the transmitter and receiver in a telephone exchange system, is the switchboard. This constitutes as it were the nerve centre of the whole system and any delay or derangement at that point must always work to the disadvantage of the subscriber. In these days of strict enforcement of patent rights it is not easy to evolve improvements of a non-infringing nature, but this very state of affairs has stimulated invention to a more than ordinary degree, and among the apparatus which has recently been constructed of this nature is the telephone switchboard of the Eastern Electric Co., of Philadelphia, built under the Gould-Smith Patents.

Before entering into a description of the various interesting details of the new board it may be well to point out the fundamental principle upon which it is based, which is expressed perhaps as well as could be done in the claims of two of the Gould-Smith patents. One of these reads as follows: "In a switchboard system, the combination with the main line of a movable terminal and a line-opening mechanism substantially as described, whereby the terminal is automatically moved to open the line, and is held open upon a current passing through the line, substantially as set forth." The other claim reads:

"In a switchboard system the combination with a metallic circuit line having two contact points connected with different portions of the line, of a movable contact piece which connects both contact points when in its normal position, thereby completing the circuit and shifting mechanism substantially as described connected with said contact piece whereby the latter is automatically separated from said contact points by a current passing through the line thereby opening the line, substantially as set forth."

FIG. 1.—THE EASTERN ELECTRIC TELEPHONE SWITCHBOARD.

Reduced to actual practice this means that when the subscriber rings up "Central" the very act of ringing opens his line, a visual signal is displayed to the operator at the Central Office, and the subscriber's bell stops ringing. He thus knows absolutely that his call has been registered. Should the subscriber's bell continue to ring, he would know at once that his line was grounded or out of order; hence he may notify the manager promptly and save valuable time for himself. The switch-board also automatically informs a subscriber if his line or instruments are defective, and thus each subscriber tests his own line.

FIG. 2.—THE EASTERN ELECTRIC TELEPHONE SWITCHBOARD.

Secrecy of communication has always been a desideratum in telephonic exchange work, and in the present system it is impossible for an operator to go in on either of the lines locked together, as shown in Fig. 2, with plugs 38 and 61 locked in 61 terminal. It follows from this that one never hears the operator asking "Are you through?"

Two moves of the operator to connect, and two to disconnect, from the first call of the calling subscriber to the replacing of the plugs to normal position, after the ring off, is all that is required with this system; that is, a number nearly three times less than is required with the boards in use at present, and evidently resulting in just so much quicker service.

The fact that each subscriber has an individual cord, enables the operator to connect 100 per cent. of the calls; or in other words in a 100 terminal board, 50 of the subscribers can call up and be connected with the remaining 50. This reduces the "busy" calls to a minimum, as the operator is not forced to say "Busy" to a calling subscriber for want of connecting cords, when in reality the subscriber asked for is not using his line at all. Thus each subscriber's private line is extended throughout the system, ready for instant use, and it is not necessary for the operator to search for idle connecting cords, even if the system admitted of her doing so.

Any current of sufficient strength to attract the armature will instantly and automatically open the line, the same action taking

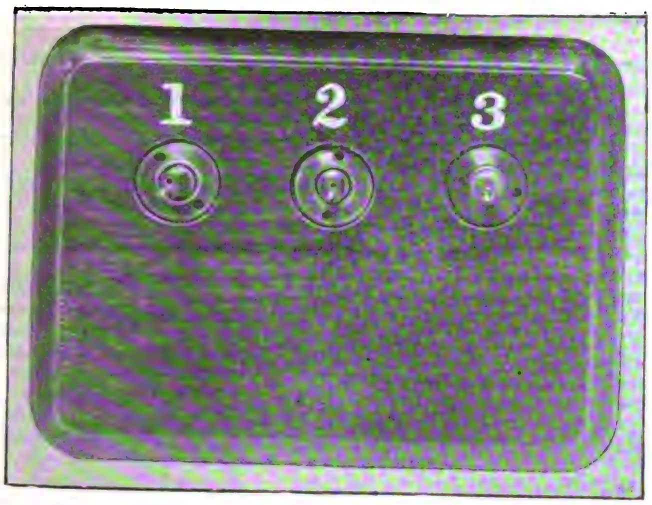


Fig. 3.—Plugs at Normal Position.

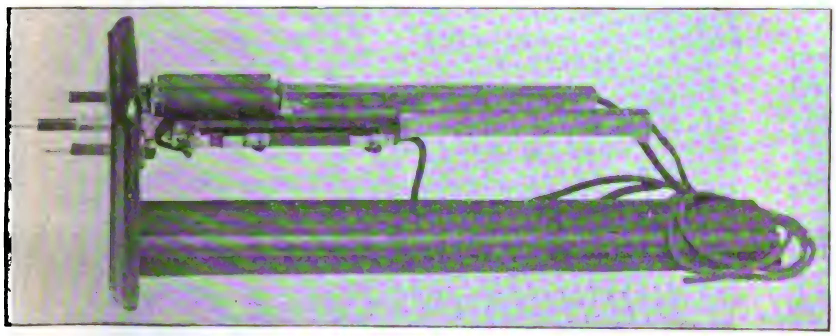


Fig. 4.—Plugs Showing Subscriber's Call Registered and Line Automatically Opened by Subscriber's Ring.

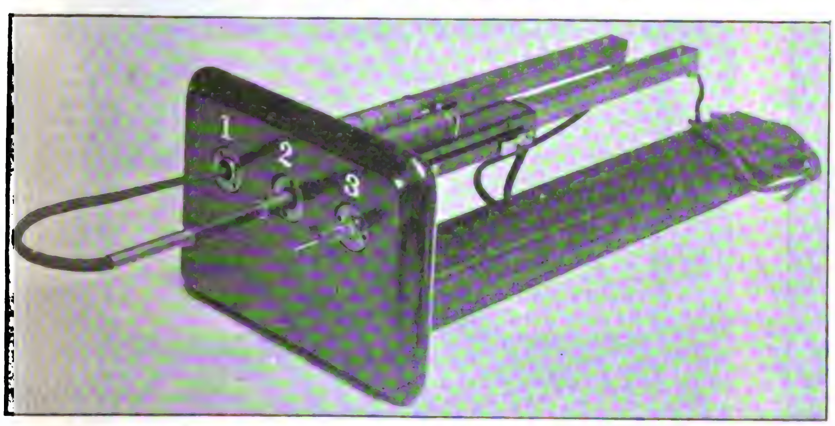


Fig. 5.—Plugs Coupled and Pushed In.

Fig. 6.—The Completed Connection.

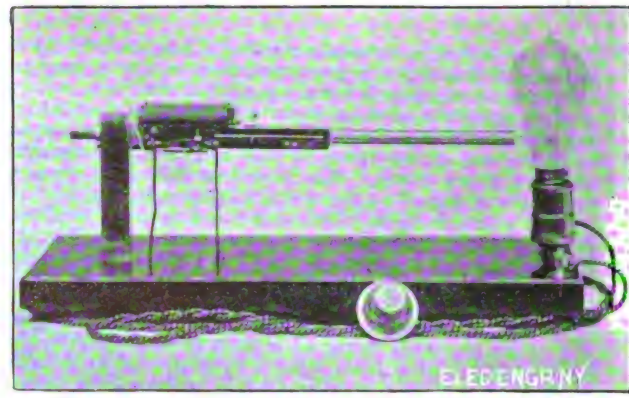


Fig. 7.—Test of Fire Proof Quality of Subscriber's Terminal.

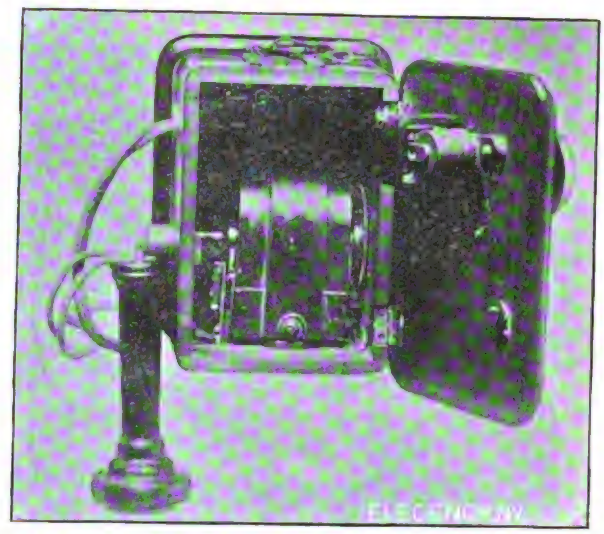


Fig. 9.—Gould Receding Hook, Modified Form.

Fig. 10.—Gould Push Button Desk Set.

place as when a subscriber calls. This is all the lightning arrester necessary, as any current that is not strong enough to attract the armature, is not a dangerous one.

This principle has been thoroughly tested in actual practice as regards lightning and the result is highly satisfactory, not a coil being burned out by lightning that had been playing on the board during a heavy storm. The same test held good when a 110 volt current was turned on the terminal shown in Fig. 10.

The principle upon which this board is built enables it to be constructed and put together one terminal complete at a time; in fact it cannot very well be built any other way, each terminal being separate and distinct in itself.

The engraving Fig. 1 shows a full front view of the "Individual Cord" metallic circuit switch-board for 100 subscribers' terminals, the space occupied being 14 square inches. The terminals are secured 1¼ inches from centre to centre of hole, bringing the plugs the same relative distance (1¼ inches) from each other in every direction. The front piece with 100 perforations shows the small handles attached to the device that enables the operator to manually take the slack from the telephone cord, thus avoiding the weight patent. The pedal at the bottom of the board serves as a foot push to ring subscribers' bells, by depressing it at the proper time and ringing the called subscriber.

It will be noticed that there are no annunciator aprons, clearing-out annunciators, levers, push-buttons, or any other similar device whereby the subscriber signals, is answered, is connected with another subscriber, or rings off. The individual plugs and their connection with their respective terminals perform all of these functions, and two plugs connected together form a complete and absolutely secret metallic circuit between two subscribers.

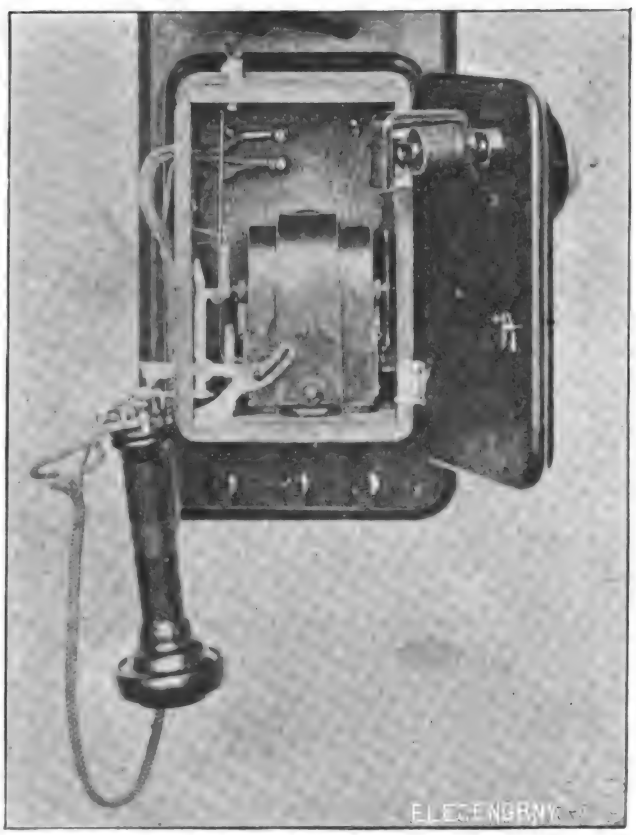


Fig. 8.—Interior View Showing Gould Receding Hook.

The side view Fig. 2, of the 100 terminal board shown in Fig. 1, gives a good representation of the position of the connecting plugs and cords in their four different positions, as shown in Figs. 3, 4, 5 and 6. These show respectively the normal position, the subscriber's call registered, two subscribers connected together and the subscribers rung off.

Referring in Fig. 1, to plug 94, this shows the subscriber's call registered. 68 and 10 are connected and ready to be locked in 10 terminal. 88 and 61 are connected, locked and talking through 61 terminal. 81 and 100 shows number 100 rung off; the remainder of the plugs are normal.

It will be noted that there are a number of holes unfilled by terminals. Thus any subscriber's terminal can be put in or removed at will, without interfering in the slightest degree with any other one in the board, as there is no electrical or other connection between the two terminals until the two plugs are coupled together.

Referring again to Fig. 3, this shows a front view of the board at rest, with plugs at normal in the three terminals.

The side view, Fig. 4, shows No. 2 subscriber's call registered and the line automatically opened by the subscriber's ring. The advanced position of plug No. 2 will be noted. The operator now presses No. 2 plug back as far as she can, thus looping in the telephone circuit and asks: "Number?"

After ascertaining the number wanted, the operator couples the two plugs together as shown in Fig. 5 and pushes them in, when they reach the point where the operator spoke to the subscriber in Fig. 3 after he called. A depression of the foot push shown in Fig. 1 cuts out the telephone circuit and cuts in the generator circuit, thus ringing the called subscriber's bell. This is done as the operator pushes the plugs by the contact points towards the point of locking.

Fig. 6 shows the position of a completed connection, as finished, from the point of ringing the called subscriber, as shown in Fig. 5. The plugs are now locked in, and the operator cannot loop in on the connection until the subscriber rings off. When the subscriber rings off, and the automatic action takes place, the plugs are thrown out of the terminal in which they have been locked and take the same position as shown in Fig. 5, which is the operator's notice that they are through talking.

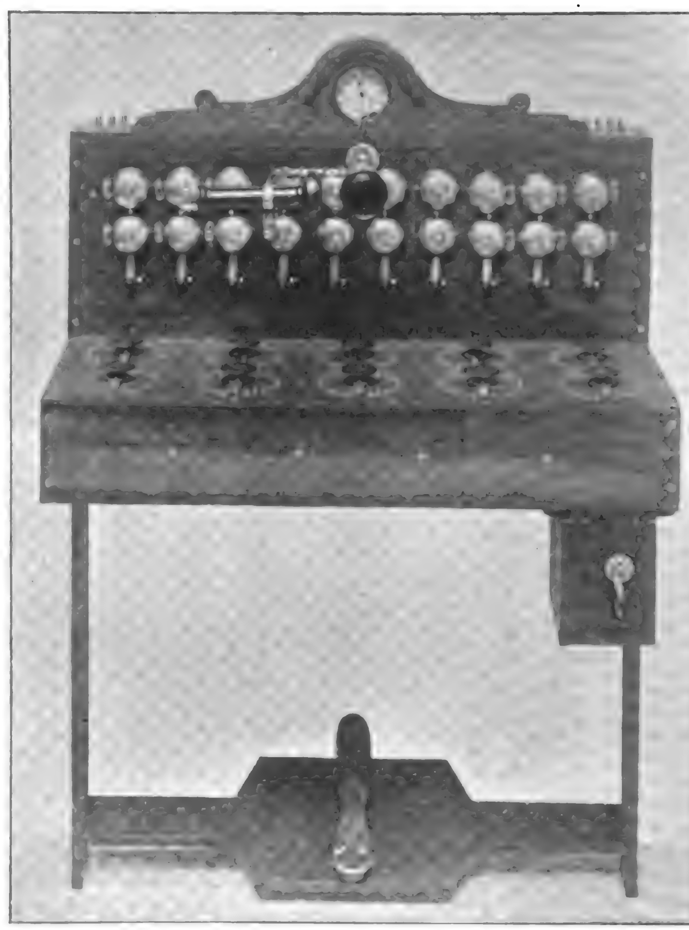


Fig. 11.—Eastern Electric Territorial Board.

When a connection is locked in, as in Fig. 6, the coils of No. 1, are shunted, and No. 2 are in circuit for clearing off. The act of withdrawing any one of the cords from a terminal, shunts those coils.

Fig. 7 represents one subscriber's terminal arranged to demonstrate the point that electric light or other high tension currents will not destroy the coils or set fire to the switch-board. It is connected up in series with the coils and a 16 c. p. lamp by the usual attachment. During a recent test, the automatic action on the terminal (when the 110-volt current used in the building was turned on,) was so quick that the lamp failed to show the slightest glow of light. The lamp was prompt to light, however, when the plug was pushed in and the line held closed.

Fig. 8 shows an inside view of the Gould receding hook, a forcible reminder to the subscriber to ring off when through talking. When the subscriber removes the receiver, the hook automatically

disappears in the case of the bell, and will not appear again until the subscriber turns the crank and rings off, when the hook for the reception of the receiver re-appears. There is thus nothing to bang the receiver on until the subscriber rings off.

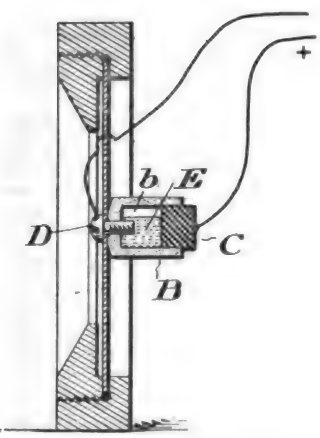
A different arrangement of the same principle, with an additional feature is shown in Fig. 9. When the subscriber rings his bell, the receiver is released by that act, and he cannot replace the receiver without ringing off.

Fig. 10 represents the Gould push button desk set for interior use, with either battery or magneto circuit, using but two wires for calling, return call, and talking circuit.

Fig. 11 shows the territorial or long distance board which has been in practical use for some time past. It is designed for metallic circuit, the extra binding post at the top being ready for a ground or the second wire for the metallic circuit. One half of the terminals can be used for ground circuits and the other half for metallic and connections can be made between them. The terminals are so constructed that the operator can loop in on any connection without interrupting. These boards are made with the automatic action or fixed ground.

THE PAIGE LIQUID TELEPHONE TRANSMITTER.

WHERE solid substances alone have been employed, either in the form of an electrode or in the form of a plurality of bodies interposed between a moving and a fixed electrode, the necessary variations have, in accordance with the usually-accepted theory, been produced by variations of pressure or in intimacy of contact between the approximate surfaces. Where, on the other hand, liquids or plastic bodies have been interposed between the moving and the fixed electrodes the variations of resistance have been effected by the physical approach or recession of the moving electrode toward or from the fixed one, and the corresponding



THE PAIGE LIQUID TELEPHONE TRANSMITTER.

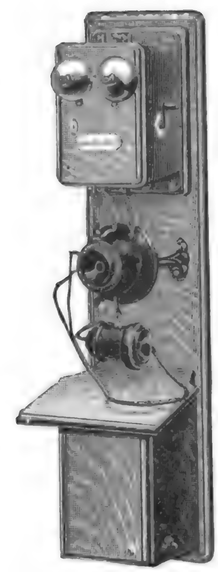
changes in the length of circuit, extent of immersion, or other consequences of the movement of one electrode relatively to the other.

Mr. Arthur E. Paige, of Philadelphia, in a patent just issued to him, states that he has discovered that the necessary modification of the electric current for the reproduction of sound-vibrations can be accomplished by the mere agitation of a liquid conductor, such as mercury, interposed between two separated electrodes, which are maintained in unvarying relation to each other during the transmitting operation.

A transmitter constructed on this principle is shown in the accompanying engraving. As will be seen, the diaphragm carries at its centre a vulcanite cup B, secured to the diaphragm by means of a metallic screw D which penetrates into the interior chamber *b*, within the cup. A plug C, made of carbon, is fitted tightly into the mouth of the cup, so as to form a completely-inclosed chamber *b*. This chamber is partly filled (before the insertion of the carbon plug) with mercury, as indicated at E. The terminal wires of the telephone circuit are connected respectively to the screw D and the carbon plug C, so that the screw and the plug constitute two solid electrodes or terminals of the circuit, which when once set up at the proper distance remain absolutely fixed in their relation to one another. The circuit across the interspace is of course completed by the mercury E.

Mr. Paige has found in operation that the effectiveness of the instrument is enhanced by coating the surface of the mercury by a mere film of certain materials, which are capable of adhering thereto, such as graphite, of the kind ordinarily used as stove-polish, or glass, each being in the form of an impalpable powder. From the different electrical characteristics of these two materials it would seem that the modification of the mercury by them must lie in some direction which is not directly cognate to the conducting or non-conducting character of this film. To produce the effect the merest pinch of the powdered material may be dusted upon the mercury and the surface be then blown upon vigorously until every particle which can thus be removed has been blown away.

THE "COLUMBIA" TELEPHONE.



Columbia Telephone Set.

We publish herewith a cut of the new "Columbia" telephone now in use by the Capital Telephone and Telegraph Co., between Sacramento and Folsom, California, on the same pole lines as the high potential power circuits (see page 115, this issue of THE ELECTRICAL ENGINEER). The apparatus has been on the market some time, but has lately been radically overhauled, remodeled and improved by Mr. William M. Miner, well known as an expert inventor and electrical engineer, who has now become chief electrician for the makers of it, the Columbia Telephone Manufacturing Co. of No. 138 Front street, New York city. Mr. Miner has reorganized the whole electrical department of the Company, and the telephones are giving remarkable satisfaction, as to durability, clearness of transmission, freedom from inductive disturbance, and permanence of adjustment.

The Columbia Company has been shy of mere daily newspaper notoriety, but has in no sense been idle, its output of instruments having steadily increased until it could in some degree keep pace with orders. Besides supplying instruments, the Company is now building and equipping switchboards guaranteed to be perfectly free from infringement. One for several hundred subscribers has already been installed in Sacramento, to take care of over 500 subscribers secured there already by the local Capital Telephone Co.

THE CENTRAL UNION "BOGY."

THE Central Union Telephone Co. is issuing the following pithy little notice to those who venture to use other telephones than its own:—

Subject: Infringement Notice.

CENTRAL UNION TELEPHONE COMPANY
GENERAL OFFICES.
Ashland Block, Randolph & Clark Streets,
CHICAGO.

............, ..., 1895.

....
....

Dear Sir:

THE CENTRAL UNION TELEPHONE COMPANY having within the County of...... , State of.........., the exclusive right for the American Bell Telephone Company's appliances covered by its patents; and having erected and now operating its telephone lines and equipment in reliance upon such rights, hereby gives you the following notice:

The American Bell Telephone Company owns Letters-patent No. 463,569 granted to Emile Berliner, November 17, 1891, for a combined telegraph and telephone, covering all forms of microphone transmitters or contact telephones.

Respectfully,
CENTRAL UNION TELEPHONE COMPANY,
By H. H. MATLOCK,
Superintendent.

TELEPHONE NOTES.

SANDUSKY, O.—B. I. Lamb has been appointed to superintend the construction of the new Sandusky telephone line.

MARTINSVILLE, IND.—The Martinsville Telephone Company has been formed; capital stock, $7,000.

DECATUR, ILL.—The Harrison Telephone Co. plant at Decatur has been sold to satisfy a judgment for $9,488.18.

MEMPHIS, TENN.—The Standard Telephone Co. is seeking a franchise in Memphis.

LOGANSPORT, IND.—The City Council has granted E. B. Overshimer a franchise to construct a new telephone system here. The new plant will be in operation by Oct. 1.

LONOKE, ARK.—The Southwestern Telephone and Telegraph Company has been granted a permit by the Lonoke Council to erect its posts and wires. The line will be erected to Devalls Bluff this month.

BEL AIR, MD.—The poles for the Harford Telephone Company have reached Havre de Grace, and the wires have been strung. Connection has now been made with Churchville, Carsins' Run, Aberdeen and Bel Air.

NORTHAMPTON, MASS.—The offices of the New England Telephone and Telegraph Co. have been seriously damaged by fire.

WESTMINSTER, MD.—The Chesapeake Telephone Company is re-building its line from this city to Baltimore.

INDIANAPOLIS, IND.—The Universal Telephone Company are putting in a system of their telephones for Schnull & Co.

SHERBROOKE, QUE.—The Sherbrooke Telephone Company, anti-Bell, has declared a half yearly dividend of 3 per cent.

MASSILLON, O.—At the meeting of the stockholders of the Farmers' Telephone Company it was decided by a unanimous vote to increase the capital stock from $10,000 to $20,000.

NEW HAVEN, CONN.—The Southern New England Telephone Company's dividend for the quarter ending June 30 is announced as 2½ per cent.

APPLETON, WIS.—Frank Merriman, manager of the Appleton and Kaukauna telephone exchanges has resigned and his place will be filled by Chas. Avery, of Stevens Point.

FORUM, N. D.—The Telephone Co. have requested and were granted permission to put in a water motor to generate their own current. They grant the city the use of two telephones in return for the water.

BUTTE CITY, MONT.—C. A. Davidson, formerly of the telephone service at Anaconda, has taken the position of manager of the Rocky Mountain Telephone Company here, vice F. W. Groff, resigned.

DETROIT, MICH.—It is stated that the Brown telephone company will give each alderman and the head of each city department a telephone free of cost, if the Brown ordinance becomes a law.

EVERETT, MASS.—It is very probable that Everett will soon have a new local telephone company. H. H. Hunt, George H. Conant and H. C. Pierce, the sole agents for the Century Telephone Company, are at the head of the enterprise.

LA CROSSE, WIS.—The new La Crosse Telephone company has entered into a contract with the American Telephone company of Kokomo, Ind., for a complete central station outfit with a 500-drop switchboard and as many long-distance telephones. The contract price will almost reach $10,000.

YORK, PA.—It is proposed to apply to the state for a charter for an intended corporation to be known as "The Octoraro Telephone and Telegraph Company," the object of which is to construct a system of telephone wires and instruments in Chester, Lancaster and York counties.

FULTON, IA.—The Whiteside-Harrison Telephone Co. has finished its canvass for subscribers and has 115. It has subscribers also in Sterling, Morrison, Prophetstown, Tampico, Spring Hill, Lyndon, Fenton, Erie, Albany, Gardenplain, Fulton, Malvern, Coleta and Penrose, this county, and Clinton, Iowa, and it intends to run its line into every town in the county.

KENOSHA, WIS.—The National Telephone Construction company of Milwaukee, has presented an ordinance to the common council granting a franchise for the erection and maintenance of a complete metallic circuit long-distance telephone system and asked that it be passed. The ordinance states that the system must be completed and in full running order within six months and is not to cost more than $30 per year for business telephones and $18 per year for residences.

NEWPORT, R. I.—The Nixon Telephone and Electrical Supply Company of Providence has finally succeeded in establishing here a line of its new telephone system. The system is what the company calls its "Railroad Telephone System" and is intended to cover a railroad section of sixty miles or more, the wires starting from the train despatcher's office and extending along the side of the tracks, with the company's patent box connections, at, say, every 500 feet.

LEWISBURG, PA.—A telephone company, with a capital stock of $10,000 has been organized in Lewisburg. The purpose is to extend the lines to every part of Union County, the central station being at Lewisburg. Communication will be opened with Winfield, New Berlin, Mifflinburg, Millmont, Hartleton, Laurelton, Forest Hill, Kelly Cross Roads, Allenwood and all intermediate points. The officers are J. T. Baker, President; C. H. Hassenplug, Secretary; C, F. Shaffer, Treasurer.

GOLDEN CITY, MO.—A meeting of the stockholders of the Golden City Telephone Company has been held and it was decided to build a line to Lockwood, thence connecting with Greenfield. The contract has been let to the Dunlap Construction Company of Springfield, Mo. Several big telephone projects are now on foot. A line is being run from Greenfield to Stockton, thence connecting with Bolivar, Humansville, Fair Play and other points. A company will be organized to build a line to Jericho, twenty miles north of this point. Southwest Missouri will soon be connected by a perfect network of telephone wires.

ASHLAND, KY.—H. H. Fowler, manager of the East Tennessee Telephone Co., has received a new switchboard.

LITTLE ROCK, ARK.—The capital stock of the Little Rock Telephone Company has been increased to $100,000.

COLEBROOK, N. H.—The Colebrook, Stewartstown and Connecticut Lake Telephone Co. has declared a dividend of 6 per cent.

BARABOO, WIS.—The Wisconsin Telephone Company has asked for a franchise from the Baraboo City council.

ALBANY, N. Y.—The Home Standard Telephone Company of Albany, N. Y., has been incorporated. Capital stock, $350,000.

ISHPEMING, MICH.—The Marquette County Telephone company has begun stringing wires for its new telephone system.

EAGLE GROVE, MINN.—The Phoenix National Telephone Company, of Indianapolis, has been granted a franchise to put in an exchange in the city.

SHEBOYGAN, WIS.—The ordinance granting to Messrs. End, Winter and Johann a telephone franchise has been given a second reading and passed by the unanimous vote of the council.

HUNTINGTON, KY.—Huntington's new Mutual Telephone Co. is assured of success, as contracts for the placing of the exchange have already been let to the Old Dominion Construction Co., of Richmond.

Mr. W. F. BURNS has passed through San Francisco on his way to Japan, on behalf of the Standard Telephone Co., which has, it is asserted, an exclusive concession for certain telephonic work in the Empire.

SAGINAW, MICH.—A plan is on foot with the board of trade in the background looking to the organization of a new local telephone company, composed of people residing in the valley cities, Saginaw, Bay City and West Bay City.

LANSING, MICH.—D. A. Reynolds has notified the Common Council of the acceptance of the franchise recently granted the Lansing Telephone Exchange and presented the required bond to hold the city harmless for all damages which may result from accidents occasioned by the company.

JASPER, IND.—The Jasper County Telephone Company has been incorporated with a capital stock of $8,000. Those back of it are: James T. Watson, C. C. Sigler, E. L. Hollings and Delos Thompson, all of Rensselaer, and the system will include Jasper, Newton, Benton, Porter, Lake, White, Pulaski, Starke, Laporte and Tippecanoe counties.

PLYMOUTH, N. H.—The Plymouth & Campton Telephone Exchange Company has purchased the property of the Franconia Telephone Company, including a service of 25 miles through the famous Franconia notch. This will give through telephone service up the Pemigewasset valley through the Notch to the mountains beyond, a long felt necessity.

DES MOINES, IA.—The Globe Telephone and Construction Company will file articles of incorporation. The capital stock will be twenty thousand dollars and the business will consist of constructing and equipping telephone exchanges. The instrument is the invention of a Hungarian, J. Serdinko, of San Antonio, Texas.

YARMOUTH, ME.—Articles of incorporation have been filed for the Yarmouth Telephone Co., which has been organized for dealing in electrical goods, constructing telephone lines, various tools, etc. The capital stock is fixed at $10,000, with $80 paid in. The incorporators are Albert H. Coombs, John Coombs and Geo. E. Coombs, all of Yarmouth.

FARMINGTON, ME.—The annual meeting of the Dirigo Telephone Company of Maine has been held, and the following officers elected for the ensuing year: President, George M. Seiders, Portland; secretary and treasurer, Charles E. Marr, Farmington; general manager, Seth E. Beedy, Farmington. It was voted to establish headquarters for the company in Portland, and also to manufacture telephones and telephone appliances there.

NEWARK, N. J.—The Newark Mutual Telephone Company has had its articles of incorporation recorded. The company will do a general telephone business in this city. The capital stock is placed at $300,000 and business will be commenced with $1,000. The incorporators are Earnest J. Foord, of Jersey City; P. Justus Atkinson, of New York City, and Samuel L. Boyd, of Brooklyn, N. Y.

FRAMINGHAM, MASS.—The new Framingham Telephone company has organized for business, and chosen Michael F. Maher, of Saxonville, president, H. A. Worthley of Boston treasurer, Geo. H. Conant of Boston secretary, and H. H. Hunt and H. C. Pierce both of Boston, the other two members of the board of directors. The company has received a franchise to locate in Framingham and the Natick selectmen have held a hearing for one in that town. If the latter is granted, the two plants will be run under one charter. The company is capitalized for $15,000.

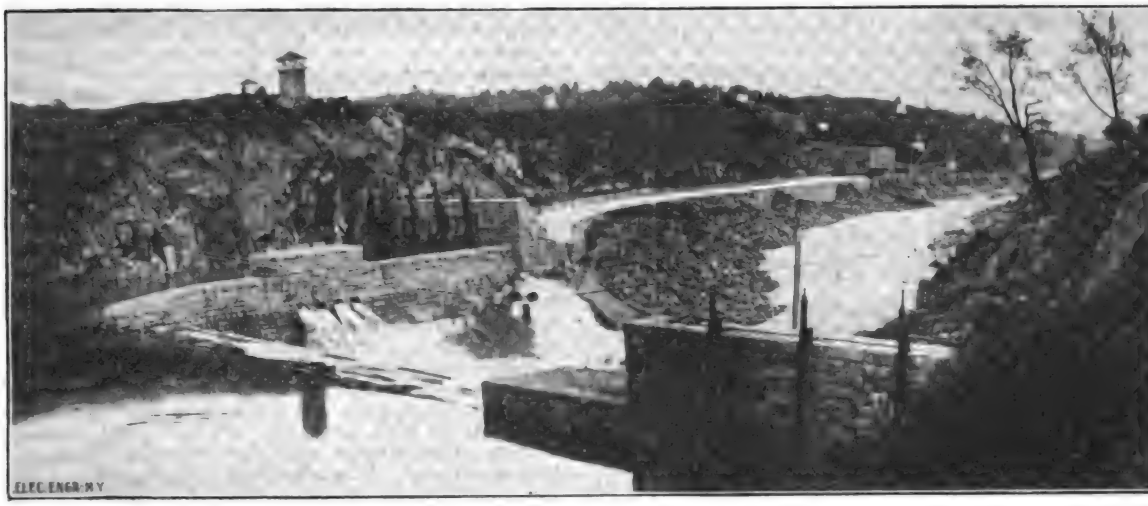


FIG. 1.—DAM AND CANAL OF THE FOLSOM-SACRAMENTO ELECTRIC TRANSMISSION PLANT, FOLSOM, CAL.

INAUGURATION OF THE FOLSOM-SACRAMENTO 3-PHASE POWER TRANSMISSION PLANT.

ON July 14 current was transmitted for the first time over the new 3-phase transmission plant between Folsom and Sacramento, Cal., and has continued in successful operation from the start. In our issue of February 13, 1895, our special correspondent, Mr. H. Guy, gave the first details of this interesting installation which constitutes one of the largest enterprises of its kind in the country and which cannot fail to have a marked influence on the future of power transmission in California.

The power is derived from the water of the American River confined by a dam 650 feet long, 24 feet wide at the top and 87 feet wide at the bottom and 89 feet high at the highest point. The storage basin thus formed is 3½ miles long and has a capacity of 13,000,000 cubic yards. A canal runs from the dam along the side of the river down to the power plant and mill sites, opposite Folsom. This canal is 50 feet wide and 8 feet deep, carrying 85,000 cubic feet of water per minute. Its walls are built in large part of solid masonry, the work having been done largely by prison labor under a contract with the State.

The river has a fall of 82 feet from dam to power house, and of this fall seventy feet can be utilized for power, producing when fully utilized 10,000 horse-power.

The plant now installed has a capacity for generating 4,000 H. P., and two of the four generators necessary to produce this are now placed, and two more are on the ground ready for setting on the foundations. Our engraving Fig. 2 shows the power house of the Sacramento Electric Power and Light Co., which covers a cut in the solid rock 60 feet deep, 100 feet wide and 150 feet long.

The discharge of the water from the canal into the power station is regulated by four gates, so that any one of the four 1,000 horse power generators can be used independently of the others; Fig. 3 shows the penstocks and turbines. These latter of the McCormick type are of 1,200 H. P. capacity each and run at 350 R. P. M. under a head of 55 feet. They were built by the S. Morgan Smith Works, of York, Pa., under contract with the Pelton Water Wheel Co. of San Francisco.

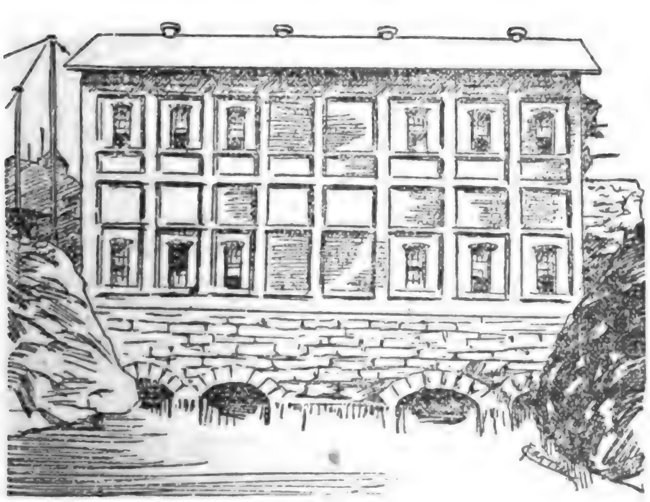


FIG. 2.—THE POWER HOUSE AT FOLSOM.

The dynamo room is arranged for four 1,000 H. P. 3-phase generators built by the General Electric Co., coupled direct to the turbine shafts. These machines weigh 40 tons each and are the largest 3-phase machines built thus far. They deliver current to step-up transformers which raise the potential to 11,000 volts on the line.

The double pole line from Folsom to Sacramento is 22½ miles long. The poles are of red cedar, 40 feet long, 16 inches in diameter at the butt; they are set 105 feet apart and carry five cross arms, 4 x 4 inches by 7 feet long, placed 16 inches one above the other. At present the three top arms each carry two No. 1 bare copper wires, and the 3-phase current is delivered at Sacramento to step-down transformers. The transformed current is led to three 3-phase motors of 300 H. P. capacity each which drive street railway generators and arc light machines.

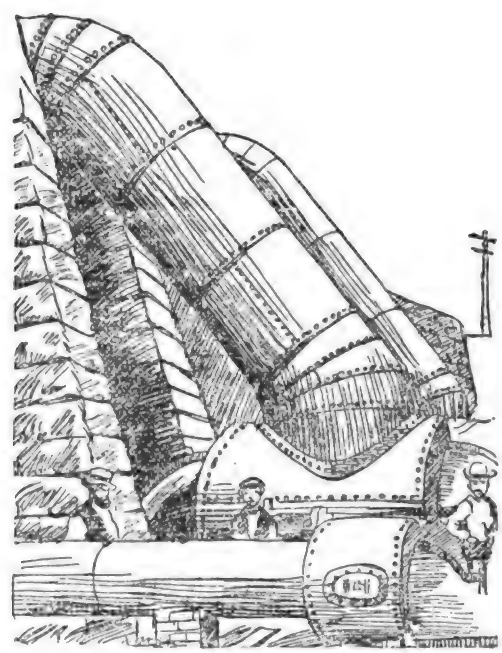


FIG. 3.—PENSTOCK AND TURBINES.

An interesting feature of the installation is the telephone line, which connects the power house at Folsom with the station at Sacramento. The liability to induction at first deterred the managers of the enterprise from stringing the telephone wires on the same poles as the power transmission wires, but Mr. Chas. E. Severance and Mr. V. J. Mayo, E. E., of the California Telephone and Construction Co., of San José, Cal., the agents of the Columbia Telephone Co., in California, undertook the work. The tele-

phone conductors are placed on the lowest pole arm and 40 inches from the nearest power conductor. By a skillful system of transposing the wires no trouble whatever is experienced from induction, and the articulation of the Columbia telephones over the distance of 22½ miles is perfectly clear. Considering the length of the line and the great proximity of the disturbing wires the feat accomplished is well worthy of notice.

LONG DISTANCE TRANSMISSION AT 10,000 VOLTS.

(The Pomona Plant.)—II.

BY GEORGE HERBERT WINSLOW.

There are two transmission lines, one 13¾ miles long which supplies Pomona, and another 28¾ miles long, which supplies San Bernardino. Each line consists of two No. 7 B. & S. gauge wires. The joints in the wire are made with McIntire connectors. To further improve the joint the ends of the wires were bent back side by side and soldered together. After the Pomona line was completed and the first ten miles of the San Bernardino line was put up, the supply of connectors ran out, and the regular telegraph joint was substituted. The conductivity was assured by soldering as before.

The wires are supported upon large double-petticoat flint-glass insulators designed for this plant. These insulators are of perfectly clear flint-glass, which gives a better surface-insulation than is attainable with any other kind of glass.

It was at first proposed to use oil insulators. The reason they were not used was because the glass companies which had undertaken to furnish them found on trial that they could not make them without considerable experimenting, which would have delayed the installation of the plant. This was no doubt fortunate, as the country through which the line passes is subjected to hot, dry winds which not only blow dust onto the insulators, but also inside them, and during the day the sun beats on the insulators until they become so hot that they nearly blister one's hands. If oil were used under these conditions it would soon evaporate and thicken, and become filled with dust. It would therefore seem undesirable to have used oil insulators in this case, or to use them in any other until an increased voltage makes them necessary, and the transmission of greater amounts of energy over the circuits justifies the additional expense necessary to keep the insulators in good condition.

The Stillwell regulator has long been recognized as a valuable adjunct to the central station operating a number of feeders of different lengths from a single dynamo. Its utility is still greater in a system of long-distance transmission in which, as was the case in this plant during its first year of operation, the transmission circuits are supplied from one dynamo, since it is not practicable to install such a system so as to operate with small line-loss and therefore means must be provided to compensate for the large differences in the pressure at the ends of the lines. The use of regulators at the power-house was impossible while but one bank of raising transformers was used for the two circuits. Even when it became possible by the use of separate banks of transformers, it was still undesirable because the attendant at the power-house would often have to work both the regulators simultaneously to properly compensate for changes in load, and his attention would be required by the regulators at exactly the time he should be free to attend to the generators and water-wheels. A regulator was therefore placed at each sub-station, as already stated. These are each of 2,000 lights capacity and have a range of 10 per cent. up, and 10 per cent. down. This variation of 10 per cent. (100 volts) is divided into 14 equal parts, so that each step corresponds to 7.1 volts. The distribution from both sub-stations is effected in the usual manner at 1,000 volts for incandescent lighting, the only point of interest being that a considerable number of Helios arc lamps are successfully used on the circuits.

While in use the transformers in the sub-stations give forth a continuous hum which depends for its tone on the number of alternations. This is an excellent indicator for the attendant, whose attention is instantly called to any change in the running conditions of the plant by the resulting change of tone. Its indications not only mark changes which are taking place and which can be detected on the voltmeter, but also give notice of coming changes before there is any other indication of them. It is thus possible to foretell a coming drop in voltage in time to use the regulator and thus keep the voltmeter needle perfectly still, though the voltmeter is a very sensitive instrument, and the regulator is often moved four or five notches. The hum often changes, however, without any corresponding movement of the voltmeter, but the sound is then somewhat different. At rare intervals the switchboard lights will suddenly change slightly in candlepower before any change is noticeable on the voltmeter.

It is noticeable that the needle will often stand for a time perfectly still on the centre, and, on a slight rise in the hum, will start gently rising, never more than three-quarters of an inch, and then as the tone gradually becomes lower, slowly fall back to the centre and stop without passing it. At other times the variation in hum is more sudden and the needle will rise and oscillate above the centre. Again, the needle will oscillate equally about the centre during a regular rise and fall of hum, its movement being apparently due to one impulse and not seeming to be modified by subsequent variations. There is no apparent change in candlepower of the lamps during the voltmeter changes noted. These notes were made while the plant was running at only 5,000 volts, but they were later confirmed when using 10,000 volts. During dry weather there is considerable intermittent oscillation of the voltmeter-needle without there being any change in load or any other apparent cause, while in wet weather, the needle remains perfectly still for many minutes at a time, often for as much as half an hour. A possible explanation of this oscillation may be found in the presence of static charges on the line, due to atmospheric electricity. That the line is often heavily charged from the air is shown by a number of observations. One afternoon a painful shock was obtained on touching the line at the canon end, drifting clouds and a strong wind being noticed in the valley. Again, while using the telephone a report was heard in it so sharp as to cause momentary deafness. Later, after a moderate wind had been blowing for some time, loud reports were noticed on the telephone at long intervals. As the wind became higher the reports came oftener and the intervals between the reports became shorter. It was evident that there was a discharge from the lines through the telephone (which was on a metallic circuit) and that it depended on the rate at which the wind blew. In order to get the strongest effect the two wires were connected in the usual way to the raising and lowering transformers, and one side of the telephone connected to one wire. On connecting the other side of the telephone to ground, a sharp report was heard, and on maintaining the connection there was a sound as of steam escaping at a distance, with intermittent and very faint crackling. If the ground contact was made slowly there was a bright spark before the metals touched, and a loud report. If the fingers were interposed a smart shock was received. By making and breaking the ground connection rapidly, the line was prevented from accumulating a heavy charge, and no spark was visible, though a faint crack was heard. If a slight space was left between the telephone wire and the ground, a spark occurred at fairly regular intervals, and when the space was lessened the sparks became smaller and more frequent. When the wind lessened the sparks and reports became almost imperceptible, but on the wind becoming strong and blustery a large spark was again obtained. When one line wire was disconnected from the transformers at Pomona the effect obtained from grounding that wire was less owing to the reduction in capacity.

These observations, which were made on the Pomona circuit during hot, dry and cloudless weather, show conclusively that the lines were heavily charged by the action of the wind. The wind no doubt blows electrified air and dust against the wires, the latter thereby accumulating a static charge with a rapidity which we have seen depended on the speed of the wind.

BOILER INSPECTION IN MASSACHUSETTS.

Two acts have been passed by the last Massachusetts Legislature with regard to the more thorough inspection of boilers and the qualifications of engineers and firemen in charge of such plants. Boilers are to be inspected at least twice a year, under police control, and the owner is to pay $2 for each boiler inspected, each time. The State has been divided into four districts, and the appointees are: 1st Dist., Thos. Hawley, State House, Boston; 2nd Dist., C. Fergerson, Borden Block, Fall River; 3rd Dist., John H. Wilson, 426 Main street, Worcester; 4th Dist., Geo. H. Lord, 327 Main street, Springfield. The engineers' licenses will be in three grades; the first, unlimited as to size of plant; the second, limited to 150 h. p. and the third limited to 50 h. p.

PRACTICAL MEN AND DATA SHEETS.

Mr. P. Canfield Barney, C. E., Manager, Brunswick, Mo., Water and Light Works, writes: "I think the Data Sheets a great idea, and will be appreciated, I know. * * * Send morocco filing case." Mr. P. P. Crafts, Electrician, U. S. Navy Yard, Boston, says: "I take pleasure in saying that I think the Data Sheets issued in the Engineer, which paper I am strongly addicted to in my spare moments, promise to become a very useful and convenient addition to the electrical engineer's 'pocket account,' who has much business to attend to."

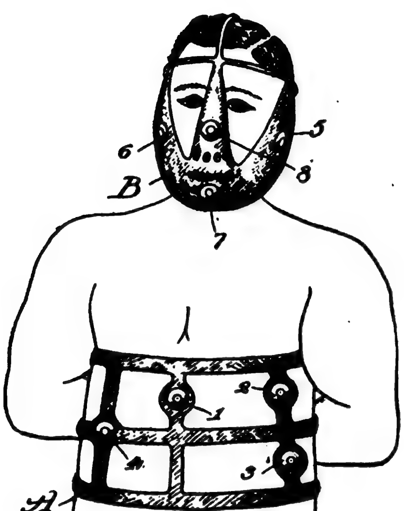
ARC LIGHTS AND CINCINNATI BUGS.

The women residents of fashionable Mt. Auburn, a suburb of Cincinnati, have appealed to the board of administration to have the electric lights abolished and to substitute gas. They say that the arc lights draw bugs which frighten them and keep the children from promenading in the evenings. They also assert in their petition that they had rather live in darkness than have the life scared out of them by buzzing beetles from dusk until bedtime. The petitioner's husbands were not consulted in the matter, so they say, and they are making the request as the wives of taxpayers and as the mothers of timid children.

MISCELLANEOUS.

REGISTERING ARMOR FOR BOXERS.

At last electricity has been brought to the direct aid of boxers, and the followers of the manly art of self defense will hail with delight the device just patented by Mr. Joseph Donovan of Chicago. We will let Mr. Donovan describe his invention in his own language, as follows: It is well known that sparring or boxing is one of the most health-giving exercises in the whole range of athletics, developing endurance, stability of physique, a quickness of eyesight and action, and tending to bring out in its finest and quickest form every muscle of the body. Unfortunately, however, with all these good qualities there is a roughness and a brutality with it, which has thrown it almost entirely outside the pale of legitimate athletics, and to eliminate these rough and



REGISTERING ARMOR FOR BOXERS.

objectionable features entirely to those practicing boxing by padding over all the vulnerable points above the belt and providing each and all of these points with a registering device, so that all blows shall be rung up and registered automatically, thus reducing boxing to a simple test of quickness and endurance, and nothing more, is the principal object of my invention.

We add also the first claim as a warning to would-be infringers: Claim 1. In an armor for boxers, the combination of a jacket or jackets, having a cushion or cushions located over the vulnerable parts of a wearer in use, and means for indicating the number of times each or all of such cushions have been struck, substantially as described.

REPORTS OF COMPANIES.

SCHUYLER ELECTRIC CO.

Judge Thayer, in the Superior Court at Hartford, Ct., has issued an order directing Lewis Sperry, receiver, to sell the property of the Schuyler Electric Manufacturing Company of Hartford and Middletown, Ct.

PECKHAM MOTOR TRUCK AND WHEEL CO.

The annual meeting of the Peckham Motor Truck and Wheel Company was held last week when the following directors were elected: Edgar Peckham, H. C. Soop, Charles Bray, W. H. Wilkinson, J. H. Burton. The following officers were elected: Edgar Peckham, president and treasurer; H. C. Soop, vice president; J. H. Burton, secretary. A semi-annual dividend of 4 per cent. was declared.

SIEMENS & HALSKE ELECTRIC CO.

The Siemens-Halske Company has elected Charles T. Yerkes, son of the street railway magnate, vice-president and a director. W. F. Furbeck, who represents Mr. Yerkes, Sr., in divers corporations, has also been made a director. O. W. Meysenburg, president of the Wells & French Company, and treasurer of the Siemens Company, retains the latter office. The full list of officers includes: President—A. W. Wright. Vice-president—Charles T. Yerkes. Secretary—F. B. Badt. Treasurer—O. W. Meysenburg. Directors—Arnold von Siemens and George Wilhelm von Siemens, of Berlin; O. W. Meysenburg, Charles E. Yerkes. W. F. Furbeck, David B. Lyman and F. B. Badt, of Chicago; Martin Maloney, of Philadelphia.

The number of directors has hitherto been five. This is increased to nine. The new directors are Yerkes, Furbeck, Lyman, trustee of the Grant Locomotive Works; Maloney, the Philadelphia magnate, and Badt, representing Yerkes. The one director dropped is Sir William Van Horne, of the Canadian Pacific Railway, who still retains his old financial interest in the works.

NEFTEL, O'CONNOR & CO.

Duncan Edwards has been appointed receiver for Neftel, O'Connor & Co., corporation, whose office was formerly at Liberty Street, New York city, on the application of John A. Roebling's Sons Company. The company was in the electrical contracting business. Bernard F. O'Connor, the Treasurer of the company obtained an attachment against it some time ago for $11,000. He said the company has assets consisting of office furniture and $20,000 bonds of the Union Electric Light and Power Company of Troy, N. Y., worth probably 25 cents on the dollar, and a claim against the Carbondale and Forest City Railroad Company of Pennsylvania.

HUDSON RIVER GAS AND ELECTRIC COMPANY.

The T. & I. Union Gas Company of Tarrytown, which some two years since absorbed the Excelsior Electric Light Co. of that village, has recently reached out and consolidated with the Dobbs Ferry Electric and the Hastings Gas Co., which latter was formerly a part of this system, and on the 6th of June was incorporated under the new title of the Hudson River Gas & Electric Company. The capital stock of the consolidation is $300,000. The officers are: president, Geo. W. Harris; first vice-president, Charles Russ; second vice-president, William Walker; treasurer, David Silver; secretary, Augustus Konrad. In view of this enlargement of boundaries, the power house of the former Excelsior Electric Company has been extended by an addition on the front to the line of Josephine Street, so as to give room for additional power and machinery. A new dynamo is already in operation and another engine has been ordered. The lines have been extended and contracts have been made with the villages of Irvington and Dobbs Ferry, to be lighted with incandescent lamps placed 200 feet equi-distant, which are now in operation, while the wires will soon be extended to Hastings, thus giving a complete circuit including the villages of Tarrytown, North Tarrytown, Irvington, Dobbs Ferry and Hastings.

EDUCATIONAL.

THE LELAND STANFORD JUNIOR UNIVERSITY.

We have received the fourth annual register (1894-1895), of the Leland Stanford Junior University. The University is located on the Palo Alto estate in the Santa Clara Valley, thirty-three miles south east of San Francisco, on the Coast Division of the Southern Pacific Railway. This University, for the splendid endowment of which California is indebted to the late Hon. Leland Stanford, was formally opened to students in 1891. The list of the faculty is imposing, and the register shows that work of a high standard is being actively and successfully maintained. Dr. F. A. C. Perrine remains in charge of the instruction in the Electrical Engineering Department.

THE UNIVERSITY OF WISCONSIN has conferred the honorary degree of LL.D. upon two men of national engineering reputation, namely, Edwin R. Reynolds, of Milwaukee, designer and builder of the Reynolds Corliss engine and Don J. Whittemore, chief engineer of the Chicago, Milwaukee and St. Paul Railway. Both degrees are eminently deserved, and the recognition of engineering work does credit to the University.

OBITUARY.

SAMUEL LLOYD FIRTH.

We note with deep regret the death of Mr. Samuel Lloyd Firth, the secretary of the Novelty Electric Co., of Philadelphia, at the early age of 23. He was the son of Mr. F. J. Firth, the secretary and treasurer of the Western & Erie Transportation Co., and was an amiable young man of great intelligence and high character, much esteemed by all who met him.

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CONTENTS.

STORAGE BATTERIES AT NIAGARA.

THE great Niagara plant has scarcely yet been put to active work, but even at this early stage it may not be premature to discuss questions of the future involving the fullest economical utilization of this power. The thing above all others which gives the Niagara scheme its value is the permanency of water supply and its never-failing continuity. The flow of water goes on uninterruptedly day and night and in steady volume. It follows, therefore, that to operate only during 10 hours of the day would be utilizing less than one-half the power available with a corresponding non-utilization of the entire hydraulic and electric plant. It is hardly to be supposed that all the industries that will be attached to Niagara will be operated 24 hours per day, and hence the inquiry suggests itself whether some method of storing the energy during the night at the power station or at the factories may not prove economical. Without enumerating the methods which could be employed for this purpose under the conditions obtaining at Niagara, there is little room for doubt that electrical storage alone can fulfill the requirements. The storage battery must therefore be looked upon as probably the next adjunct to Niagara, and just in what manner it will reach its highest usefulness will much depend upon the nature of the industries to be transplanted to Niagara. What strengthens our belief in the adaptability of the storage battery for Niagara is the character of the enterprises already established there, and that of others which we know are sure to follow and which require the continuous current as an absolute necessity in the manufacture of their products, such as the aluminum of the Pittsburgh Reduction Co., and others which we might mention. At present such establishments require an equipment of reducing static transformers, and rotary converters to obtain the current suitable for their purposes. The question is a purely financial one and involves the consideration on the one hand of the cost of wheel pits, turbines, generators, static and rotary transformers, and, on the other hand, the rotary transformers and storage batteries of a capacity sufficient to store the energy of the machines required for the day load. The problem thus presented is a simple one. The addition of a storage battery at Niagara either at the main power house or at the points where the continuous current is required would thus fulfill the necessity of affording a proper utilization of available energy, and provide two sources and two kinds of current adapted to all purposes for which current can be utilized.

ELECTRIC LINES AND SHADE-TREES.

THE Supreme Court of Errors of Connecticut has handed down a decision, of which we give a summary in another column, which is of considerable importance to electric companies. It appears that upon the construction of an electric railway through the street of a village, the selectmen ordered the telephone company to remove their poles and wires to the opposite side of the street to make room for its overhead structure. In order to make a clear passage for the wires in the new location, the telephone company were compelled to cut the limbs of a number of shade-trees standing without the highway line, but having

branches extending over the highway. A suit for damages followed, resulting in a verdict for several hundred dollars in favor of the plaintiff, which was followed by an appeal to the Supreme Court. This court now decides that the cutting or mutilation of shade-trees by an electric company even when within the highway, is a tresspass upon the rights of the adjacent property-owner for which damages may be recovered, and that even the erection of poles and wires within the highway limits is an additional use of the right of way not included in the original taking of land for that purpose, and hence one for which, in the absence of express consent, additional compensation must be made to the adjacent proprietors As we understand the decision, the Court even goes so far as to intimate that the Legislature itself has no power to authorize the occupation of highways by electric lines without the consent of the adjacent owners, although statutory provision is made for the condemnation of a right of way when necessary by the county authorities. The telephone companies, especially in New England, have for some years been accustomed to place their lines for long distances upon private land by leasing or purchasing a right of way, and it is probable that this practice will become more and more common in the future, in view of the law of highway occupation as expounded in this and many similar decisions in other states. If a right of way must be paid for in any event, it is certainly preferable on every account to keep off the highway altogether in settled portions of the country. We have for many years advocated the purchase by the electric companies of adequate rights of way between prominent cities for the occupation of the vast numbers of wires which have now become a commercial necessity, and which have become a burden and an annoyance, both on the railways and on the highways. There would seem to be little doubt that the Connecticut and New Jersey view of the law will in time come to be the settled rule in all the other states, and in that case, some such plan will become an unavoidable necessity at no distant day.

OVERLAND MESSAGES TO EUROPE.

A breath of old-time industrial romance comes with the announcement that the Western Union Telegraph Company is making arrangements to retake possession of the old abandoned telegraph line, extending through British Columbia, started thirty years ago to run to Europe via Behring Straits and Siberia. This line was constructed as part of a great world circuit to connect Europe with America. The success of the Atlantic cable spoiled this plan. Now it is proposed to rebuild the old line and put Alaska in telegraphic touch with the world. The Indians long since took the wires and used them for making salmon nets. The plan was known to the last generation as the "Collins Overland Line to Europe." It was well supported. The Russian Government began the expensive construction of the 7000 miles of line from Moscow to the Pacific Coast; while loop lines into China and India were carefully laid out. In this country the Western Union Telegraph Co. raised and spent $3,000,000, which to-day is part of the watered capital that socialistic papers are so fond of prating about but which simply represents the courage of a number of modest folk with small savings. For thirty years, the investment has lain idle and dead, while of the work to which such men as William Orton, F. L. Pope, George Kennan and scores of others gave their best thought and hardest work nothing remains practically but the memory.

Now that the Russian Empire is so closely interested in the developments in Northern Pacific waters, there is no good reason to doubt that it will endeavor to meet the renovated Western Union line at the Behring Straits. The "Russian Extension" as it was once called will not offer very serious competition with the dozen Atlantic cables, but for strategic purposes it should have a high value. It may, perchance, have some interest for the Postal Telegraph and Canadian Pacific Telegraph Companies.

THE DOUBLE CARBON ARC LAMP.

One of the electrical patents which had thus far been sustained in its entirety, the Brush double-carbon lamp, has at last met with a reverse and after years of litigation involving it is said an expense to the Brush Company alone of over $200,000 is now declared not to be as broad as it has heretofore been held to be. Although Judge Showalter has been on the bench but a short while he has signalized his elevation to it by a number of strong decisions and that now rendered in this celebrated suit shows a grasp of technical details rarely met with in the legal profession. Judge Showalter holds that the Brush patent does not cover all forms of double carbon lamps, and while not invalidating the patent he leaves the way open to other devices not specifically covered by the Brush claims. In other words, he emphasizes the tendency of all the courts against upholding "broad" patents in all their breadth.

ELECTRIC CAR HEATERS.

THE New England Railroad Commissioners have taken up recently the question of heating the street cars in winter, and have begun hearings on the subject. Vice-President Cummings, of the Boston West End, has, we are glad to see, come out strongly for electricity before the Commission, remarking: "In every case, there should be electric heaters, for it is possible to heat the cars well with this new device." There is no doubt that the coming winter will witness a larger use than ever of electric heaters on street cars, but we are awaiting with some interest the action in regard to these devices, of the managers of the elevated and ex-steam roads. Obviously, trains on such lines can be admirably lighted and warmed electrically, if the companies are willing to go to the expense of installation and maintenance; and it would seem good policy thus to get rid at once of oil lamps and stoves or steam coils.

POLICE SIGNAL TELEGRAPHS.

THE NEW YORK POLICE BOARD wants a new signal system, and invites all interested in such to submit information about them. The system must provide a modern and complete telephone and signal communication between the station house and each part of the precinct.

Legal Notes.

THE BRUSH ELECTRIC CO. vs. THE WESTERN ELECTRIC CO.—THE WESTERN ELECTRIC DOUBLE CARBON LAMP DECLARED TO BE NON-INFRINGING.

On July 24 Judge Showalter, of the United States Circuit Court for the Northern District of Illinois, handed down a decision in two suits of the Brush Electric Co. against the Western Electric Co., for infringement of the Brush double carbon arc lamp patent No. 219,208, September 2, 1879.

The claims of the Brush patent are as follows:

1. In an electric lamp two or more pairs or sets of carbons, in combination with mechanism constructed to separate said pairs dissimultaneously or successively, substantially as and for the purpose specified.

2. In an electric lamp two or more pairs or sets of carbons, in combination with mechanism constructed to separate said pairs dissimultaneously or successively and establish the electric light between the members of but one pair, (to wit, the pair last separated) while the members of the remaining pair or pairs are maintained in a separate relation, substantially as shown.

3. In an electric lamp having more than one pair or set of carbons, the combination, with said carbon sets or pairs, of mechanism constructed to impart to them independent and dissimultaneous separating and feeding movements, whereby the electric light will be established between the members of but one of said pairs or sets at a time, while the members of the remaining pair or pairs are maintained in a separate relation, substantially as shown.

4. In a single electric lamp, two or more pairs or sets of carbons, all placed in circuit, so that when their members are in contact the current may pass freely through all said pairs alike, in combination with mechanism constructed to separate said pairs dissimultaneously or successively, substantially as and for the purpose shown.

5. In an electric lamp wherein more than one set or pair of carbons are employed the lifter D or its equivalent, moved by any suitable means, and constructed to act upon said carbon or carbon-holders dissimultaneously or successively, substantially as and for the purpose shown.

6. In an electric lamp wherein more than one pair or set of carbons are employed, a clamp, C, or its equivalent, for each said pair or set, said clamp C adapted to grasp and move said carbons or carbon-holders dissimultaneously or successively, substantially as and for the purpose shown.

The Western Electric Co. set up in defense the patents Nos. 418,758, 502,535, and 502,536 issued to C. E. Scribner and assigned to them.

After quoting from the specification of the Brush patent, describing the action of the lamp, Judge Showalter says:

"The ideas of the Brush invention in suit were apparently these: (1.) By separating the added pair of carbons first he threw the entire current down the other pair, and thus determined that the arc should form between said other pair, or pair last separated. (2). By separating the added pair at a greater distance apart than the other pair he avoided accidental alternation in the arc between the two pairs. (3). By permanently holding the added pair in such separated relation, the first pair could be fed together and consumed without stop.

"The observable interval between the point of time at which the separation between the added pair of carbons takes place and the point of time at which the separation of the other pair takes place the purpose being to determine the arc between the pair last separated—is the *dissimultaneousness* found in each of said six claims.

"With all respect for the learned writer of the opinion in the Toledo case and for the learned counsel for complainant, the formula of words 'dissimultaneous arc-forming separation,' does not carry any definite meaning. The adjectives *simultaneous* or *dissimultaneous*, are words of comparison. The former means that two or more occurrences or happenings are identical in time, the latter, that they are successive—that is to say, with an interval between each two in succession. The arc-forming separation which takes place between the first pair of carbons to burn, and the arc-forming separation which takes place several hours later between the added pair of carbons, are certainly successive and, loosely speaking, dissimultaneous, but these separations lack the unity or continuity of movement implied in the term *dissimultaneous* when used in this patent. As already said, Brush coined the word 'dissimultaneous' to express the momentary but observable interval—the slight but noticeable non-coincidence in time—between the separation of the added pair of carbons and the separation of the other pair in a unitary and continuous movement due to mechanism as invented by him and described in the patent in suit, in contrast with an apparently simultaneous separation due to any mechanism appropriate for the latter purpose.

"The patentee said further in his specification: 'I do not in any degree limit myself to any specific method or mechanism for lifting, moving, or separating the carbon points or their holders, so long as the peculiar functions and results hereinafter to be specified shall be accomplished.'

"The specification and claims were evidently prepared with the idea that *the mode of movement*, to wit, the rapid, successive and continuous separations between the pairs of carbons terminating in the arc between the pair last separated, could be secured to Brush, regardless of the mechanism by which this mode of movement should be produced. In *Brush Electric Company v. The Fort Wayne Electric Light Company*, Judge Gresham held, answering the contention that the first, second, third and fourth claims were for functions or results and hence, void, that mechanism such as described in the drawings and specifications or a substantial equivalent was an essential element in each of said claims. I am not called on to determine these constructions but the conclusion reached apparently in the Toledo case that no one of these claims contains the element of dissimultaneous or successive separations between the members of each pair of carbons for the purpose of forming the arc between the pair last separated, seems to me unsound. * * *

"Without going again over the mechanism, the lamp is constructed so that the carbons A shall first burn. By reason of the support K being carried on the upper carbon-holder of the first pair of carbons to burn, and of the greater distance between the two carbons of the added pair, said added pair could not be burned first. It is, in other words, the characteristic feature of this lamp, the very purpose signified by its construction, that the position of the first arc shall be determined before lighting as between the two pairs of carbons. Yet, in the opinion in the Toledo case this is declared to be 'a wholly immaterial and useless feature.'

"Even if it were, in fact, immaterial which pair of carbons burned first—supposing it to be true that if the carbons were separated simultaneously instead of dissimultaneously the lamp would still operate—the fact remains that the patentee took from the Government claims in which the dissimultaneous separations are the special feature. Moreover the feature of dissimultaneous arc-forming separations—referring here to the interval of hours between the arc-forming separation of the first pair to burn, and the arc-forming separation between the added pair,—is not in any one of the claims. In order to make out a case of infringement, the former element must be gotten out of, and the latter must be gotten into, each claim. This in my judgment cannot be done. The lamps made under patent No. 418,758 do not contain mechanism constructed to cause the dissimultaneous initial separations of the carbons, nor do the lamps made under patent No. 502,535, nor do the lamps made under patent No. 502,536. I hold, therefore, that no infringement is made out in either suit.

"The order will be in each case that the bill be dismissed for want of equity."

ELECTRIC LINES ON PUBLIC HIGHWAYS.—RIGHTS OF ABUTTING PROPERTY OWNERS.

The Supreme Court of Errors of Connecticut sitting at New Haven, handed down on June 24, a decision in the suit of Mrs. Caroline L. Bradley, of East Haven against the Southern New England Telephone Co., affirming the decision of the lower court. The plaintiff originally brought an action to recover damages from the defendant for cutting the branches of six shade-trees standing inside the plaintiff's premises without the highway limits. Two of the trees, it appears, were trimmed by defendant's agents entering upon plaintiff's premises. In the Superior Court it was shown, on behalf of the defendant that it was compelled by order of the selectmen of the town to remove its line to the opposite side of the highway from its original location, to make room for the conductors of an electric street-railway company; and hence it was contended that defendant was justified in doing such trimming of overhanging trees as was necessary for the proper operation of its line, and that such trimming was permitted and authorized by the selectmen. It was further contended that the branches overhanging the highway constituted a nuisance to the defendant as well as to the public, which the defendant had a right to abate. The court held that the defendant's acts complained of were prohibited by statute and were an illegal invasion of plaintiff's property rights. The jury found that the trees were not a nuisance and that unnecessary injury was done in their removal, and awarded the plaintiff $800 damages. An appeal was taken by the defendant to the Supreme Court of Errors. On appeal the plaintiff contended that the trees cut were not "upon the highway" and consequently not within the jurisdiction of the selectmen; that it was immaterial whether the cutting had been done from the inside or outside of the fence; that in the absence of a special statute the jurisdiction of the selectmen was limited to the making of the street safe for travel; that the defendant's acts were absolutely prohibited by statute, inasmuch as the erection of poles and wires imposes an additional servitude upon the land embraced within the right of way, for which compensation must be made to the adjacent owner; and inasmuch also, as the statute contains an express provision that no injury shall be done to any tree without consent of the adjoining owner; and finally that any act authorizing the cutting of trees without consent of the adjacent owner and without compensation would necessarily be unconstitutional and void. This has substantially been decided heretofore in cases in New York, New Jersey, Illinois and Maryland, to be the law. As above stated, the Court of last resort decided the plaintiff's points to be well taken, and confirms the award of damages given in the lower court.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JULY 23, 1895.

Accumulators:—

Secondary Battery Plate, J. J. Rooney, Brooklyn, N. Y., 543,055. Filed Nov. 19, 1894.
A composite grid consisting of a perforated base plate and perforated coating plates.

Secondary Battery, E. Boettcher, Leipsic, Germany, 543,373. Filed May 12, 1890.
A battery containing a zinc oxide solution, a zinc cathode and a non-conducting covering that extends over the lower surface, the rim and the vertical stem of the cathode.

Alarms and Signals:—

Fire Alarm Box, J. T. Stack, Chicago, Ill., 543,063. Filed Jan. 3, 1894.
Consists in certain details of construction of a keyless box.

Registering Armor for Boxers, J. Donovan, Chicago, Ill., 543,086. Filed Dec. 19, 1894.
See THE ELECTRICAL ENGINEER, page 117, this issue.

Fire Alarm Box, C. A. Rolfe, Chicago, Ill., 543,103. Filed May 10, 1895.
An extensible hand portion normally confined within the casing and arranged to project therefrom when the frangible portion of the casing is broken.

Fire Alarm Box, C. A. Rolfe, Chicago, Ill., 543,104. Filed May 10, 1895.
A street or like fire alarm box, containing signal-transmitting means, with a telephone which can only be used by authorised persons.

Railway Signal, J. B. Stewart, Haverstraw, N. Y., 543,322. Filed Aug. 24, 1894.
A novel form of electro-magnetic clutch.

Distribution:—

Electric Transformer, J. A. Mosher, Chicago, Ill., 543,246. Filed May 7, 1895.
In a transformer, the combination with the primary coil, of a terminal block for carrying the terminals of the primary coil and of the main circuit, of a contact plug adapted to connect both ends of the circuit with the primary coil.

Testing Circuit for Alternating Current Systems of Distribution, H. C. Wirt, Schenectady, N. Y., 543,364. Filed April 23, 1895.
Means for testing transformer leakage in an alternating current system of distribution.

Dynamos and Motors:—

Dynamo Electric Machine, T. Hooker, Syracuse, N. Y., 543,081. Filed April 26, 1894.
A yoke having a coil is connected in series with the field magnets and polarized in such direction as to reinforce the entering horn of the field magnet and decrease the trailing horn of the same.

Alternating Electric Motor, J. A. G. Trudeau, Ottawa, Can., 543,233. Filed April 6, 1894.
Details of construction.

Dynamo Electric Machine, T. H. Hicks, Detroit, Mich., 543,383. Filed Jan. 13, 1894.

Electrometallurgy:—

Electro-depositing Device, J. Bossard, Dubuque, Iowa, 543,066. Filed Nov. 11, 1893.
The article to be deposited upon is caused to automatically travel through the bath.

Lamps and Appurtenances:—

Producing Pure Electric Light Carbon, E. G. Acheson, Monongahela City, Pa., 542,982. Fil d Aug. 25, 1894.
Consists in granulating coke, and subjecting it to the required degree of temperature necessary to volatilize the impurities associated with it.

Incandescent Lamp Socket, E. H. Heath, 543,016. Filed Mch. 21, 1895.

Carbon Holder, J. C. Knight, New York, 543,186. Filed Jan. 15, 1895.

Electric Arc Lamp, D. Higham, Boston, Mass., 543,243. Filed May 2, 1895.
Means whereby the normal lengths of the arcs of a twin lamp are maintained by the heat given out by the arcs.

Incandescent Electric Lamp, G. Westinghouse, Jr., Pittsburg, Pa., 543,280. Filed Aug. 29, 1893.
Details relating to a stopper lamp, which is supported in its socket without the use of intervening parts.

Electric Arc Lamp, H. J. Sage, Chicago, Ill., 543,355. Filed Feb. 18, 1895.
Details of construction.

Electric Arc Lamp, S. E. Nutting, Oak Park, Ill., 543,399. Filed Oct. 5, 1894.
The operating parts of the shunt have no direct connection with and are movable independent of the arc-drawing mechanism.

Electric Arc Lamp, W. Jandus, Cleveland, O., 543,445. Filed Dec. 19, 1894.
Surrounds the arc by an enclosed body of chemically inert gases, and surrounds such enclosure by an envelope or enclosed outer reservoir of chemically inert gases, said inner and outer enclosed bodies communicating with one another. (Has been shown in THE ELECTRICAL ENGINEER.)

Measurement:—

Meter for Alternating Electric Currents, L. Gutmann, Pittsburg, Pa., 543,039. Filed May 20, 1890.
In an electric meter, the combination with two or more stationary energizing coils, of an armature whose windings lie in different planes rigidly mounted on a shaft adapted to rotate and fans and a registering train for the purpose described.

Miscellaneous:—

Electrical Time-Annunciator, E. M. Edgerton, Chicago, Ill., 543,000. Filed Feb. 13, 1892.
Improvements upon the electric alarm clock, patented March 17, 1891. No. 448,836.

Electromedical Apparatus, J. R. Etter, Crawfordsville, Ind., 543,008. Filed June 19, 1893.
A portable electro-medical machine.

Electrically Controlled Voting Machine, C. A. Stitzer, Central City, Neb., 543,065. Filed Nov. 27, 1893.

Pneumatic-Transfer-Tube System, F. W. Jones, New York, 543,184. Filed April 15, 1895.
An electric circuit connects both stations with a switch for stopping, starting and reversing the air pump.

Process of Refining Sugar by Electrolysis, E. Javaux & C. F. Gallois, Paris, France, 543,249. Filed May 26, 1894.
Consists in adding lime in excess, to neutralize the acid constituents, precipitate the organic impurities, and prevent the formation of salts of lead, then treating the alkaline juice by an electric current.

Electric Registering Apparatus, A. Custodis, Dusseldorf, Germany, 543,336. Filed March 19, 1895.
Relates to an apparatus for electrically indicating at a distance the position of the pointer, scale-beam or other device.

Electric Clock-Winding Mechanism, L. H. Spellier, Philadelphia, Pa. 543,358. Filed May 28, 1891.

Railways and Appliances:

Trolley Wheel, C. Mitchell, Yonkers, N. Y., 543,048. Filed Dec. 20, 1894.
The contact is effected by means of balls and the trolley is provided with ball bearings.

Underground Trolley System, N. B. Ginocchio, New York, and H. C. Bridger, Woodridge, N. J., 543,130. Filed Dec. 27, 1894.
Involves an automatic switching system for throwing in successive sections as the car passes over them.

Electric Switch, J. W. Hearn, Brooklyn, N. Y., 543,181. Filed Oct. 3, 1893.
Relates to a track switch.

Trolley Stand and Pole, L. C. Seelye, Fort Edward, N. Y., 543,271. Filed Jan. 2, 1895.

Electric Brake, W. B. Potter, Schenectady, N. Y., 543,351. Filed March 28, 1895.
Means for operating brakes of trailers by means of an auxiliary generator upon the accidental separation of trailer from motor car.

Safety Appliance for Electric Cars, W. B. Potter, Schenectady, N. Y., 543,352. Fil d Apl. 9, 1895.
A controller equipped with a reversing switch having a certain additional series of contacts therein, by which the car is stopped in any emergency.

Electric Transportation System, R. E. Sherman, Chicago, Ill., 543,357. Filed Mch. 1, 1895.
A mail carrying receptacle is equipped with an electric motor suspended on an overhead track.

Electric Railway System, J. C. Henry, Westfield, N. J., 543,382. Filed May 13, 1895.
Consists in a three wire circuit fed by two generators of different constant potential, the line being divided into insulated sections, each of which is connected with that one of the generators which produces the potential suitable for that section. The rails of the track form the neutral conductor.

Means for Arresting Motion of Electric Cars, A. K. Bonta, Hoboken, N. J., 543,435. Filed Mch. 21, 1895.
A controller having one set of contacts establishing connections to send the car forward, another set to send the car backward, and the third set to reverse the relation of the field magnet and armature connections and establish a closed local circuit in which the terminals of the motor will be connected in series.

Switches, Cut-Outs, etc.:—

Electric Current Distributor, E. Thomson, Swampscott, Mass. and E. W. Rice, Jr., Lynn, Mass., 543,198. Filed April 24, 1884.
An electro magnetic cut-out device which is thrown into action by the melting of a fuse wire.

Electrical Switch, H. Stuebner, Philadelphia, Pa., 543,409. Filed Jan. 19, 1895.
Details relating to a push switch.

Telegraphs:—

Writing Telegraph, T. Ewing, Jr., Yonkers, N. Y., 543,231. Filed Jan. 9, 1894.
Relates to that class in which the movements of the transmitting pen in the plane of the paper are resolved into two components by attaching to the pen two bars placed at an angle.

Writing Telegraph, W. E. Gump, Brooklyn, N. Y., 543,241. Filed Feb. 24, 1894.
Means for connecting up the pulsator to line so as to send strong pulsations of the other polarity when the pen is moved in one direction, and means for reversing the polarities of the two sets of currents on reversal of direction of movement of the pen.

Writing Telegraph, J. H. Robertson, Brooklyn, N. Y., 543,495. Filed Jan. 9, 1894.
The fundamental telautographic operations of moving the pen and controlling its direction of movement, of lifting and lowering the pen, and of shifting the paper at the receiver, are effected by actual currents transmitted over the lines by the operation of the transmitter and not by a mere cessation of transmission of currents over either or both of the lines.

Writing Telegraph, J. H. Robertson, Brooklyn, N. Y., 543,496. Filed Dec. 19, 1894.
Details of construction relating to the above.

Writing Telegraph, J. H. Robertson, Brooklyn, N. Y., 543,497. Filed Mch. 21, 1895.
Details of construction.

Writing Telegraph, J. H. Robertson, Brooklyn, N. Y., 543,498. Filed. Mch. 21, 1895.
Details of construction.

Writing Telegraph, J. H. Robertson, Brooklyn, N. Y. 543,499. Filed Mch. 21, 1895.
Details of construction.

Telephones:—

Village Telephone System, C. E. Scribner, Chicago, Ill., 543,105. Filed Mch. July 2, 1886.
A subscriber may while signaling temporarily introduce his bell into the line of any other subscriber, said bell being automatically brought again into its own circuit after the signal has been sent so as to be in position to respond to any other call.

Telephone Exchange, W. J. Shibata, San Francisco, Cal., 543,106. Filed Oct. 11, 1894.
Details relating to an automatic exchange system.

Art of Telephoning, A. E. Paige, Philadelphia, Pa., 543,190. Filed Feb. 25, 1895.
See THE ELECTRICAL ENGINEER, page 118, this issue.

Telephone Transmitter, Z. E. Patrick, Chicago, Ill., 543,313. Filed Jan. 18, 1895.
A telephone transmitter, consisting of a hollow conical shell, and a body of variable resistance mounted rigidly upon the side walls of the cone.

Telephone Attachment, C. E. Bertels, Wilkes-Barre, Pa., 543,326. Filed March 20, 1895.
For holding the receiver.

THE GENERAL ELECTRIC CO. has received an order from the Michigan Central Railway Co. for two powerful search lights to be placed on Falls View Station terrace, with colored slides and lenses, in order to throw light upon the Falls after dark.

THE LAMB ELECTRIC CABLEWAY has been adopted for a 4-mile section of the Erie Canal, the work to be done this summer. The system has been fully described and illustrated in THE ELECTRICAL ENGINEER.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

D. P. PERRY ON THE OUTLOOK.

"The outlook for a golden harvest for the larger manufacturing companies was never better than it is to-day," says D. P. Perry, general manager of the Standard Electric company of Chicago. "The daily reports from our traveling men, local correspondents, and customers all comment on the bright outlook, and the cheerful and healthy tone pervading nearly every line of industry in nearly every community whether in the West or the South. Our correspondents lay especial stress on the plans that are being laid, or for work already contracted for, in the line of improvements and extensions by individuals and private corporations as well as public corporations. I do not recall a year in which so many and so large appropriations have been made for all municipal improvements of every character, from electric lighting plants to bridge building, and from street paving to extensions of water plants. Much of this is due not only to the improved commercial conditions that naturally follow a restoration of confidence, but also the prospects of abundant crops. Commercial travelers alone are not optimistic in this respect.

"Corporations are feeling the tonic effects of this cheerful condition and are agitating the question of the lack of economy in longer deferring certain public improvements. It is quite probable more than 100 towns now lighting their streets with oil or gas will own an electric lighting plant before the year closes."

ELECTRIC STORAGE BATTERY CO.

The Electric Storage Battery Co. reports increased business. Among the notable contracts made in last few days was one with the Anaconda Copper Mining Co. for a storage battery plant as auxiliary to their trolley system; another with the Western Union Telegraph Co. for their Washington, D. C., station; and a third to the U. S. Government for a plant at Fortress Monroe.

PORTLAND, ME., ELECTRIC WORKS.

Mr. John W. Upp, late of the General Electric Company, formerly superintendent of the Giant Motor Company, has accepted the position of superintendent and general manager of the Portland, Me., Electric Works and has entered upon his duties. Mr. Upp goes to Portland with a very high reputation as an electrical engineer, and has had valuable experience as a business manager.

CHANGES AT JACKSONVILLE, FLA.

Engineer Chas. Patterson, for nine years past chief engineer at the Citizens' electric light works Jacksonville, Fla., will take charge of the new city plant. Mr. Patterson is an electrical engineer of ability, says the local *Metropolis*, and the Board of Public Works made a wise selection in appointing him to his present post.

Mr. Patterson is succeeded at the Citizens' works by Fred Bishop, a competent electrician, formerly with the Georgia Electric Light Company of Atlanta, but who has been in the employ of the above company for several months. Both Mr. Patterson and Mr. Bishop are the right men in the right places.

SOLID SHEET INDIA MICA SEGMENTS OF A. O. SCHOONMAKER.

We have received from A. O. Schoonmaker, 150 William St., New York, a sample sheet of their various makes of stamped mica for insulating commutator segments. The types vary considerably in shape, and include the standard Westinghouse, G. E. and other forms of commutators for both dynamos and railway motors. We also notice a sheet for insulating rheostats. If the mica furnished by Mr. Schoonmaker is all of the high quality of which the samples are composed, there ought to be little trouble to its users from burn outs in generators and motors.

TURNER BROS., ATLANTA, GA.

A new electrical firm has been formed in Atlanta, Ga., the members being William W. and Oscar C. Turner, sons of Hon. J. D. Turner.

Oscar C. Turner, who will be the general manager, has been connected with the Georgia Electric Light Company for some years, having been purchasing agent for that company, while Mr. Will. Turner, the other member of the firm, is the southern agent of C. S. Knowles, one of the largest electric supply houses in the country.

Turner Brothers propose to do electric construction of all kinds, especially electric light wiring and bell work, while they further intend to carry quite a large stock of electric supplies to furnish the trade of this section. The Georgia Electric Light Company having given up wiring, Turner Brothers have secured their foreman and men and will carry on this work in the same manner that it has hitherto been done by the electric company. Besides their construction work, they intend to carry in stock a large supply of electric goods of all kinds. They have many friends who wish them all success in this venture.

UNDERGROUND WIRES IN BOSTON.

Putting the electric wires of Boston underground has progressed so favorably that the commissioners say that instead of the five years allowed for the completion of the work, it will be done inside of three years. Boston had more than 75,000,000 feet of overhead wires, requiring 12,898 poles for their support. So far 610,000 feet of duct has been laid furnishing accommodation for 200,000 feet of cabled wire, and over 26,000,000 feet of wire for telegraphic, telephonic and electric signalling purposes have been laid.

DIXON'S GRAPHITE PIPE-JOINT COMPOUND.

Twelve or fifteen years ago this article was known under the name of "Smear Grease," and later was changed to "Pipe-Joint Grease." It really is not a grease, and as the name has caused some misunderstanding, the Dixon Company have decided to change it, and it hereafter will be known as "Dixon's Graphite Pipe Joint Compound." This compound, under one or the other of its several names, has been in the market for about twenty years. It is not only useful for joints, and all steam, gas and water piping, but is equally useful for smearing gaskets and flange-joints of meters, traps, and for bolts, screws, etc. In the mills, mines and factories of the Dixon Company, this compound has been used in preference to any other article. That the Company is not prejudiced in its favor is shown by the testimonials of its customers, among whom are manufacturers of steam and hot-air radiators and heating appliances, iron companies, machinists, engineers and contractors, railroad companies, gas companies, and general manufacturers.

The President of the Water and Lighting Department of Harrisburg, Pa., said: "I have long ago forbidden the use of white or red lead or anything but your Graphite Compound in this department. The result is that we have no more breaking of bolts or nuts on our street mains, valves, etc., or any trouble of that kind in or about our pumping plant. I think those plumbers or steam-fitters who persist in the use of white or red lead are doing so purely through ignorance, as nothing is so costly, not even carelessness."

This Graphite Pipe-Joint Compound is manufactured by the Joseph Dixon Crucible Company, Jersey City, N. J.

BALL ENGINES.

The new electric light plant for the city of Wells, Minn., is being installed by Claussen & Bonwell of St. Paul. A "Ball" engine, built by the Ball Engine Co., Erie, Pa., direct connected to General Electric dynamo, furnishes the light. The Suburban Traction Co., Orange, N. J., are installing a 150 H. P. "Ball" engine. The Herald Building, Baltimore, will have an electric light plant, consisting of "Ball" engine, direct connected to a General Electric dynamo.

BOUND VOLUMES OF "ELECTRICAL ENGINEERING LEAFLETS."

The Electrical Engineer is now publishing in bound volume, price $2 each, the three series, Elementary, Intermediate and Advanced, of Houston & Kennelly's "Electrical Engineering Leaflets," and will be glad to send copies to any address, postage free, on receipt of price. The books are highly appreciated. Mr. H. A. Arvidson of Vallejo, Cal., writes: "Received bound volume, Elementary grade. Am greatly pleased with the book. It exceeds my expectations. Will order the other two volumes soon."

YOU CAN'T ELECTROCUTE THIS PARSON.

The pastor of a New England Congregational Church having bought a fan motor, wrote thus to the makers:—"However incredible it may seem, I have touched and handled with my bare hands with impunity the naked wire through which was running over 40 volts. I add this because —— —— says you are like all the others; you cannot believe it possible. In about two weeks we will demonstrate it to you, and then I will preach you a little sermon from the text 'Oh ye of little faith. Wherefore did'st thou doubt?' And that is Scripture, too."

"SAVE US MUCH TROUBLE AND TIME."

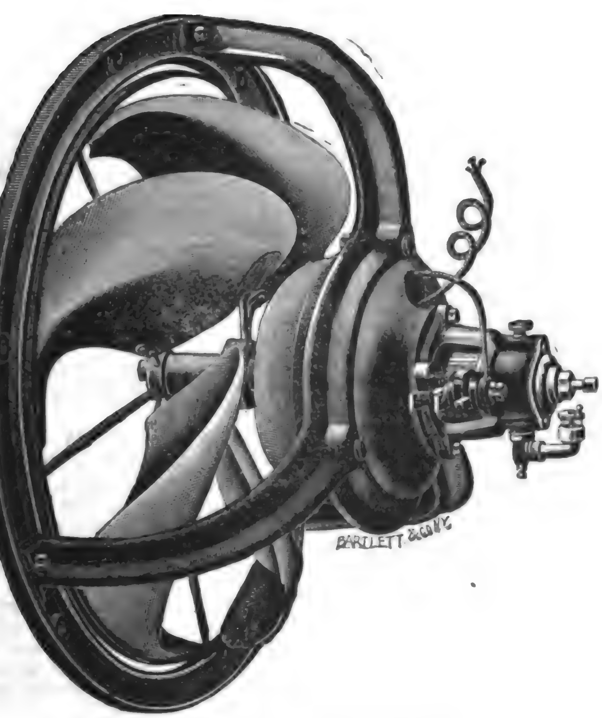
Mr. E. Carl Breithaupt, the consulting electrical engineer, of Berlin, Ont., writes us: "Please send me a morocco filing case for your Data Sheets. These sheets are an excellent idea and save us much trouble and time."

LUNDELL EXHAUST FAN OUTFITS OF THE INTERIOR CONDUIT AND INSULATION COMPANY.

The new circular of the Interior Conduit and Insulation Company, 527 West 34th St., N. Y., on their improved Lundell Exhaust Fan Outfits will be gladly received by the trade after the phenomenal record that the company has made in the sale of fans during this summer. During one of the hot spells, the daily orders were for 400 fans, and on one occasion they mounted up to 2,100 in four days, the record breaker being 1,400 in one day. In exhaust fan work the success of the company has been equally great, and this is unquestionably owing to the peculiar adaptability of the Lundell motor which is used in conjunction with it. The motor, being iron clad, is almost wholly inclosed and easily permits of connection by radial arms, spider, or bolts to any of the many forms of exhaust fans now to be found in the market.

Instead of the usual bearing in front as well as in the back of the fan, a shaft, which may be horizontal or vertical, is carried in two bearings in the motor frame itself, not supporting the shaft in any sense from the fan ring. This course insures perfect alignment and noiseless running.

All exhaust fan outfits are made with horizontal shafts, unless otherwise ordered, and are invariably made so that the direction of the flow of air is from the motor toward the fan. If it is desired to operate the fan with a vertical shaft or to drive the air through



LUNDELL EXHAUST FAN OUTFIT.

the fan and over the motor, it should be specifically stated in the order. With all standard horizontal shaft fans, an adjustable thrust bearing, as shown in cut, is provided. When the flow of air is desired contrary to the standard direction, a button and thrust bearing is placed at the rear of the motor.

In all horizontal shaft fans, lubrication is effected by oil. In vertical shaft fans, lubrication is effected in an oil receptacle enclosing a step at the bottom of the shaft, and a graphite or other self-lubricating bearing (never a grease cup or oil bearing) at the upper end of the shaft.

CREOSOTED WOOD CONDUITS.—The Michigan Pipe Co. of Bay City, Mich., issue a very interesting and instructive pamphlet, under the above title with regard to their creosoted wood conduits for all classes of electric service. It deals with the subject under all its various heads, and enumerates a number of undoubted advantages possessed by this useful and economical form of conduit, now being so largely adopted in these days of subway work.

THE AMERICAN REFLECTOR & LIGHTING CO. of 271-3 Franklin street, Chicago, have issued a very neat and useful little pamphlet of their "Paragon Reflectors" and kindred specialties. A great many excellent appliances are shown for service in connection with incandescent lamps for interior and exterior work. There are also stage dimmers, theatrical lamps, "incandescent calciums," clusters, &c.

C. C. SHELLEY & SON.

The announcement is made by Mr. C. C. Shelley that he has admitted to partnership his son Charles C. Shelley, Jr., and that the style of the firm will now be as above. The event is of more than usual interest. The house was founded as far back as 1854, and is therefore one of the oldest printing and publishing concerns in New York. It has done a high class of business from the start, including magazine work with De Vinne, and the bulk of the printing and blank book making for some of the largest insurance and drug houses in America. It has also had the patronage of many electrical concerns, including the General Electric, the telephone companies, the cable companies, etc. It has printed THE ELECTRICAL ENGINEER continuously since its first issue in 1882. Among its book publications—which include also a large quantity of religious literature—may be mentioned Foster's "Central Station Bookkeeping"; Noll's "How to Wire Buildings"; and Martin & Sachs' "Electrical Boats and Navigation." The new partner in the firm is a practical printer and publisher, having already spent several years with his father. The firm announces an increase in facilities and an installation of new machinery. It is worthy of mention that Mr. Shelley, senior, was one of the first printers in New York to recognize the advantages of electric power, and that THE ELECTRICAL ENGINEER, as well as all the other press work in the establishment at 66 Park Place, has for years been done by electric motor.

AN APPLICATION OF ELECTRICITY TO THE BLEACHING OF OILS AND FATS.

IT has recently been claimed that oils and fats may not only be bleached, but sweetened and purified generally by treating them with an electric current. The system upon which this is effected is as follows:—There is a tank divided into two parts by means of a porous partition; in one of the compartments thus formed is placed a solution of common salt at 8° Twaddell strength, and immersed in this solution is a carbon electrode. In the other compartment there is a mixture of the oil or fat with a similar salt solution, and immersed in the mixture is a copper electrode. A continuous electric current is then generated by means of a dynamo, the oil and salt solution being agitated by mechanical means at the same time.

APPROPRIATION FOR MUNICIPAL ELECTRIC LIGHT PLANT.

The following is a digest of the opinion of the court in *Christensen* v. *City of Fremont* (63 N. W. Rep. 364).

1. The power conferred upon cities of the second class, having over 5,000 inhabitants, to provide for and regulate the lighting of the streets implies the power to erect and maintain an electric lighting system for that purpose.

2. From the power to provide for and regulate the lighting of streets, however, no power can be implied to erect or maintain a lighting system for the purpose of supplying light to private buildings.

3. The latter power is conferred upon such cities by Sess. Laws, 1889, c. 19.

4. That an act providing for the levy of a tax and the issuing of bonds for erecting and maintaining a lighting system provided how money must be raised for the purpose when it is not already available; but where a city already has in its general fund sufficient unappropriated funds it may appropriate and use the funds for the purpose of erecting a lighting system.

5. A city of the second class, having more than 5,000 inhabitants, may make special appropriations for improvements at other times in other ordinances than the annual appropriations bill, provided such appropriation first received the sanction of the majority of electors either by petition or at an election.

NEW YORK NOTES.

THE NASSAU COMPANY in Brooklyn has at last been permitted to put its trolley system into operation. One can ride to Canarsie for five cents.

GENERAL ELECTRIC ACTIVITY.—Vice-President Ord states that the General Electric Co. now has 4,400 men at Schenectady, with a weekly pay-roll of $45,000,—900 men at Harrison, N. J., and 2,000 men at Lynn.

THE NATIONAL CONDUIT MFG. CO. of the Times Building, New York, have issued a large and very handsome pamphlet. It contains a view of their factory at Hastings-on-Hudson, a technical description of their work and methods, and a fine series of half-tone cuts illustrative of their installations for different classes of work in all parts of the country. Some of these pictures, by the way, give an admirable idea of the difficulties encountered in laying down a subway system.

CANADIAN NEWS.

MR. ROBERT ANDERSON, electrical engineer, of Ottawa, is installing a plant of 600 incandescent lights at Van Kleek Hill, Ont., for Col. Wm. Higginson. Mr. Anderson is also installing a 100 lt. electric plant for the Geo. Matthews Co., Ltd., for their pork packing establishment at Hull, Que. Mr. Anderson recently placed the following motors, viz.: one 5 H. P. motor for Ottawa Plating Works, one 1 H. P. motor for the Carling Brewing Co., one ½ H. P. motor for O. Robert, one 1 H. P. motor for Ratterton & Bro., one 1 H. P. motor for Fotheringham & Popham, stationers.

NEW ENGLAND NOTES.

THE SIEMENS & HALSKE ELECTRIC CO., of America, have removed their New England Office to the Equitable Building, Boston. Henry C. Radford is manager.

THE OLD COLONY-SHAWMUT STEAM ROAD is looked upon as probably the next in the vicinity of Boston to be electrified. It is a short line and devoted almost exclusively to suburban passenger traffic.

MR. HENRY SACHS (late Kaliske) has now opened an office at Room 20 A, Equitable Building, Boston, as a broker in notes, stocks and bonds, and will be glad to handle the business in these lines of any of his friends. His acquaintance with the electrical trades, through his former connection with the Beacon Company, should render him a good financial intermediary in such lines.

PHILADELPHIA NOTES.

500 IN PENNSYLVANIA.—There are no fewer than 500 street railway companies chartered in the State of Pennsylvania. Some day they may all be running. Eight years ago there were only 60 such corporations in the State.

THE EASTERN ELECTRIC CO., whose non-infringing telephone switchboard is illustrated and described in this issue, have secured an order for a 400 subscriber board. This order was given, it is said, after a thorough examination of all boards on the market.

MR. L. H. MCINTIRE has resigned as general manager and engineer of the People's Traction Co. of Philadelphia and has been succeeded by Mr. Beetem, who is also a well-known electric railway expert.

SUSQUEHANNA, PA.—Arrangements are being made to construct a three-mile electric road between Susquehanna and Lanesboro. A. W. Cook, secretary of the Susquehanna Elec. Lt. Ht. & Pr. Co., has the matter in charge, and as soon as the estimates are completed will proceed to organize the company.

MR. JAMES MURTLAND, who for some four years past has been the secretary of the Pennsylvania Electric Engineering Co., of Philadelphia, has resigned and has now established himself in business at 918 Betz Building, where he will devote himself to the handling of electrical specialties, more particularly in the field of light and power. He will also represent the "Rival" Oil purifier, which is in use in a great many plants with marked success.

WESTERN NOTES.

THE WESTERN TELEPHONE CONSTRUCTION CO. report the sale of 100 telephones at Wapakoneta, O.

THOS. G. GRIER, of Grier Brothers, Western Managers of the Bryant Electric Company, has just returned from a six days' bicycle trip through the southern part of Wisconsin.

ST. LOUIS, MO.—It is stated that negotiations are going on for the purchase of all the St. Louis street railways by English capital.

INDEPENDENCE, MO.—W. R. Whaley, formerly superintendent of the Citizens' Electric Light Company, has accepted a position with the Rapid Transit railway as an electrician.

CALIFORNIA.—Business is reported booming in California, and one of the reasons is said to be the increasing use of electric power in mining operations.

ST. LOUIS, MO.—The Interstate Complete Electric Construction Company of 818 South Seventh street, has confessed judgment to the United Electric Improvement Company in the sum of $7,763.

PARK CITY, UTAH.—The water in the Ontario mine has been converted from a burden into a blessing by means of running it into a drainage canal that discharges by flume over a Pelton wheel at a height of 120 feet. The wheel runs an alternating current dynamo of about 100 H. P. whose current is carried three miles to the company's works where it lights the mills, &c. and runs motors in the machine shops. The plant is to be enlarged. Only one man is needed to run it.

THE MILWAUKEE ELECTRIC MANUFACTURING COMPANY, with a capital stock of $8,000, has filed articles of incorporation. The incorporators are John E. McKivitt, Mathias Weisser, Joseph C. Schmitt and Henry W. Newton.

THE A. W. HARRIS OIL CO. whose main office and factory is located at Providence, R. I. have re-established their Chicago office at 1325 Monadnock Building. Mr. Urban W. Frink well and widely known in the West takes the management of their Western business in place of Mr. B. S. Terry, who now looks after the Eastern business.

APPLETON, WIS., is a great sufferer, in its industries, by the order of the U. S. Government totally suspending the use of water from the Fox River. Its electric lighting and street railway plants, which have heretofore depended upon the river for motive power, have been seriously crippled and have had to order steam equipment.

C. E. WOODS & COMPANY, a firm which consists of Clinton E. Woods and Charles E. Corrigan, have reorganized their business into a corporation under the firm name of C. E. Woods Company, with a capital stock of $100,000, their purpose in doing so being to take up a class of heavy electrical engineering in all parts of the world; and they are now making detailed arrangements to open offices in New York, San Francisco and Tokio, Japan. Their principal business will be the designing of heavy electrical apparatus and equipment, by Mr. Woods. This concern now has contracts with three manufacturing companies to design all of their apparatus, and act as consulting engineers, besides much miscellaneous work in general engineering.

NEW YORK NOTES.

H. B. COHO & CO. have notified the trade that they have become the New York agents for the Eddy Electric Mfg. Co. During the past twelve months they have installed over 5,000 H. P. of motors and generators.

SYRACUSE, N. Y.—The Syracuse Storage Battery Co. have furnished an outfit for the store of Dey Bros. & Co., to supplement the isolated plant which shuts down at 6 p. m. The installation was made by the Electrical Engineering & Supply Co.

THE INTERIOR CONDUIT & INSULATION CO. have issued a neat descriptive and illustrated circular with reference to their new generators for gas engine service recently brought to notice in the ENGINEER. The sizes range from 8 h. p. up to 45 h. p., the voltage being from 115 to 150.

NEW YORK CITY.—It is understood that the Westinghouse (Wheless) underground system is to be adopted on the Eighth avenue line. The method was recently described in THE ELECTRICAL ENGINEER, and is of the sectional class, the track only being "live" as the car passes from contact to contact.

MR. FRANK S. DE RONDE, general sales agent of the Standard Paint Co. said last week: "Our goods are still keeping to the front, and we are selling more "P. & B." than ever. Their sale is rapidly increasing in all parts of the world, and we are daily in receipt of orders not only from our old customers but from many new ones. Our references are the many customers who have dealt with us for the past ten years. From present indications, we anticipate doing a very large business in the Fall."

J. L. SOMOFF, 11 Park Row, has issued a neat catalogue of his miniature incandescent lamps, of which he has so long and so successfully made a specialty. Mr. Somoff has wonderful taste and ingenuity in this line, and many of his lamps are marvels of beauty or of oddity. In these respects, he well deserves to be called the American Trouvé. He does not confine his attention, however, to decorative small lamps, but makes them for physicians and dentists, and for many useful purposes in the arts and sciences. His prices are reasonable, and he is quick to embody and carry out any new idea or suggestion.

MR. J. W. GODFREY, of the India Rubber & Gutta Percha Insulating Co., accompanied by his nephew, Mr. R. J. Simes, Jr., son of the auditor of the New York *Herald*, and a member of the business staff of THE ELECTRICAL ENGINEER, left for Europe on July 24, on the "City of New York." Mr. Godfrey's departure was signalized by a little banquet at Mouquin's on the preceding Monday, and by a private dinner party given by Dr. Habirshaw at Delmonico's on Tuesday; while numerous evidences of esteem were sent on board the steamship before she sailed. Mr. Godfrey expects to join his wife and daughters in Paris, and will make a run through France, Switzerland, Germany and England before his return in September.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

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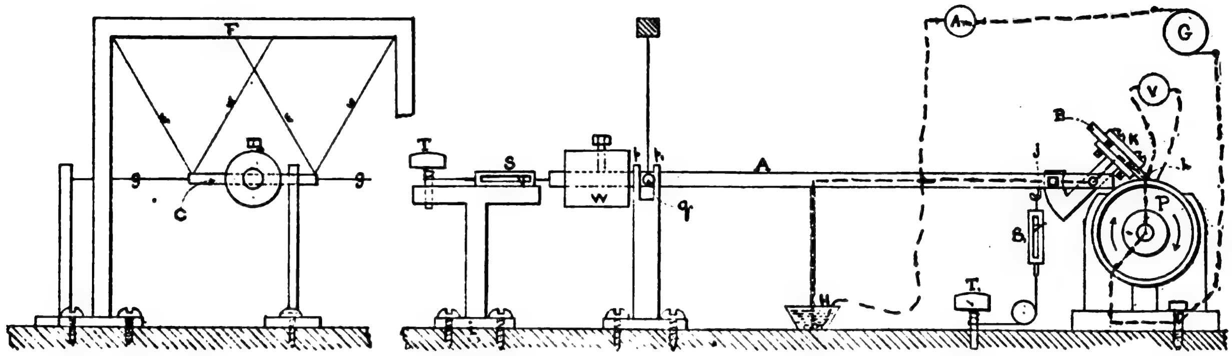


FIG. 1.—DIAGRAM OF APPARATUS FOR TESTING BRUSH FRICTION ON COMMUTATOR.

THE RELATIONS BETWEEN PRESSURE, ELECTRICAL RESISTANCE AND FRICTION IN BRUSH CONTACT.[1]

BY E. V. COX AND H. W. BUCK.

LITTLE or no information is available concerning the relations existing between the three fundamental quantities involved in the brush contact of electrical machinery, and the lost power resulting from poor adjustment of the brushes. The following investigation was, therefore, undertaken with the object of furnishing some accurate data on this subject. Those engaged in the management of dynamos and motors, while carefully attending to most of the details, apparently decide at what pressure the brushes shall be used more from common experience and guess-work than from any knowledge of a scientific nature.

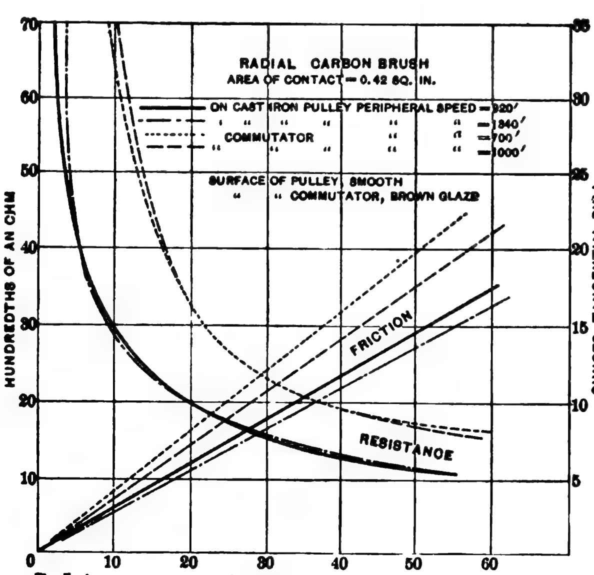


FIG. 2.

The method adopted in making this investigation can best be explained by reference to the accompanying diagram, Fig. 1. The electrical resistance of the brush contact on the various surfaces employed, was determined by the fall of potential method, using a Weston ammeter and millivoltmeter. The normal pressure of the brush on the cylindrical surface upon which it was sliding and the tangential pull due to the resulting friction were measured by delicate spring balances.

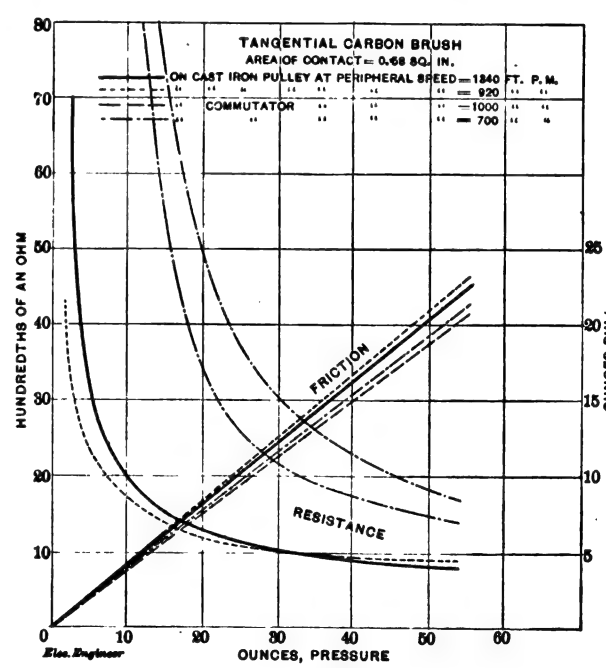


FIG. 3.

In the diagram, P represents the position of the various commutators and other cylinders experimented upon, which were mounted upon the shaft of a one horse power motor, where the pulley is ordinarily placed. The cylinder was thus caused to revolve, giving a sliding contact to the brush, similar to that existing in ordinary practice.

The brush B was carried in the holder K which was connected to the lever arm A by a swivel so that the brush could be placed at any desired angle with respect to the

1. Electrical Engineering Thesis, Columbia College, New York.

surface. The arm A was suspended at the point q by means of the cross bar C and the four wires w, w, from a rectangular frame work F which was fastened to the floor. This arrangement enabled longitudinal motion of the arm to take place with minimum friction, and at the same time effectually prevented all twisting of the brush through rotation of the arm about its axis. To prevent the brush from moving laterally on the surface of the contact cylinder, two guys G, G, were placed horizontally on either side of the arm A. The scale S and thumb-screw T were used to produce the various pressures on the brush; the lengths of the lever arms $q\,j$ and $q\,h$ being considered in calculating the actual pressure on the cylinder. To balance the weight of the arm A and attachments, the weight W was placed on the arm and adjusted until there was no pressure on the brush. By means of the thumb-screw T the pressure could therefore be varied from zero to any desired number of pounds. The two pins p and p_1, on either side of the cross-bar C, limited the longitudinal motion of the arm A to a tenth of an inch. They were so adjusted that with zero pressure on the brush the cross bar just touched the pin p_1. When pressure was applied to the brush, a tangential pull resulted, due to the friction between the brush and the revolving cylinder. The pin p_1 prevented

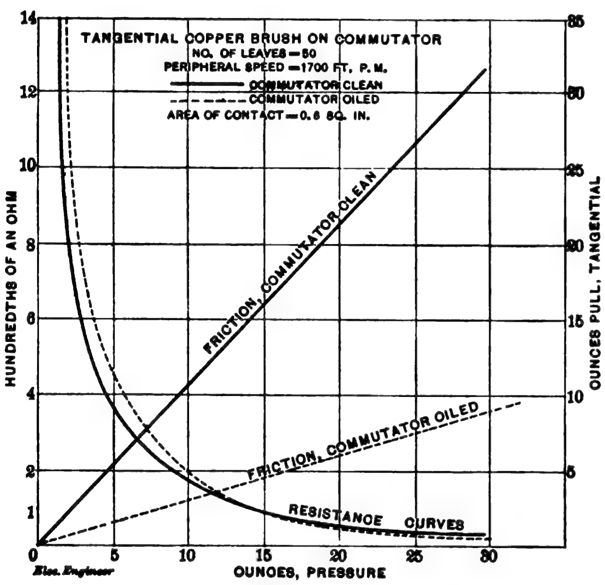


FIG. 4.

this pull from displacing the brush. The force just necessary to draw back the bar C from the pin p_1, was the value of this tangential pull and was measured by means of the scale S and thumb-screw T.

The electrical resistance of the brush contact was found by the fall of potential method as follows: the current through the brush, measured by an ammeter A m was furnished by the generator G, the circuit being completed as shown by the dotted line in the diagram, H being a mercury contact. The drop between the brass brush holder, which was one quarter of an inch from the point of contact, and the revolving cylinder, was given by a voltmeter V.

The accompanying curves represent the simultaneous relations existing between the normal pressure of the brush on the cylinder, the electrical resistance of contact and the tangential pull due to friction, abscissae measuring pressure in ounces and ordinates resistance in ohms, and in the case of the friction curves the pull in ounces. Each curve is plotted from the average of four curves taken under similar conditions; the curves agreeing within a few per cent. and each of which was obtained from ten observations taken between zero and four pounds pressure; hence the curves shown are each the result of forty observations. Fig. 2 shows a comparison between the resistances of a radial carbon brush on a cast iron pulley and on a commutator, the diameter of the commutator being 3 inches and that of the cast iron pulley 3.6 inches. Fig. 3 shows the same comparison for a tangential

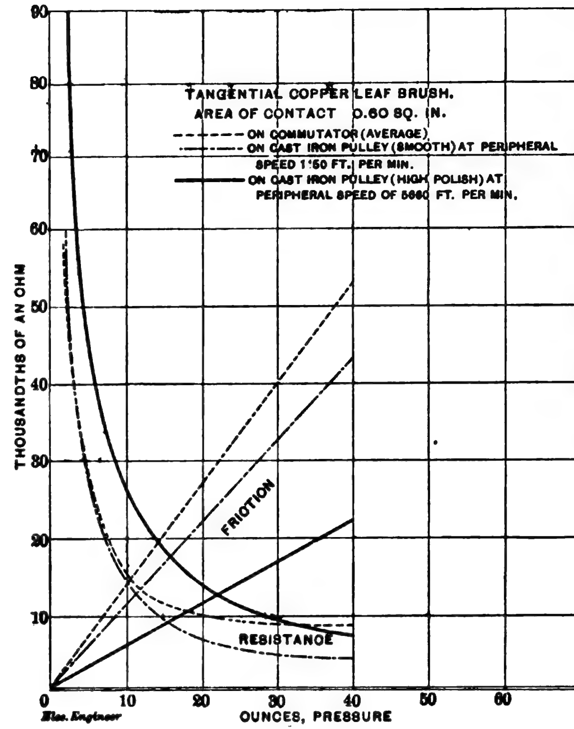


FIG. 5.

carbon brush. Fig. 4 shows the result of oiling the 3-inch commutator when a tangential copper brush is used. Fig. 5 shows the comparative resistance of a tangential copper leaf brush on a commutator and on two cast iron pulleys of different diameters. The diameter of the commutator was 3 inches; that of one cast iron pulley

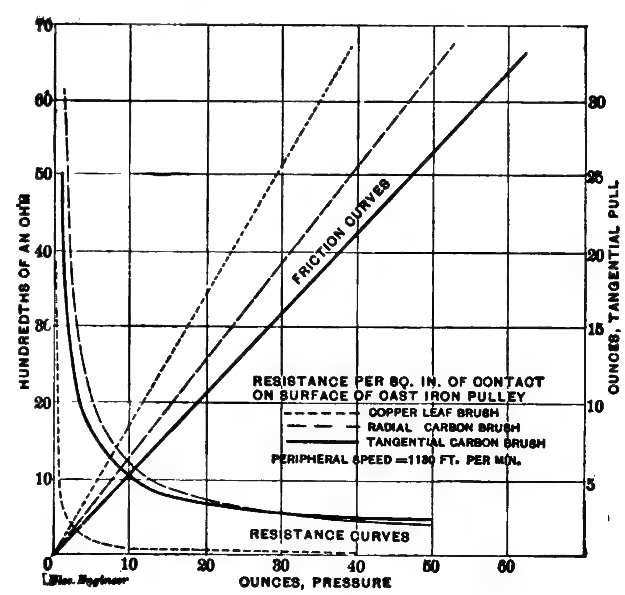


FIG. 6.

was 3.6 in. and that of the other 10 in. Fig. 6 shows the resistance per square inch of contact for three different brushes on the same cast iron pulley the diameter of which was 3.6 inches. Fig. 7 shows the same comparison when a three inch commutator is used. From these curves, the following conclusions can be derived:

1. The resistance of the brush contact does not vary

inversely as the pressure, for beyond a certain point a great increase in pressure produces only a slight diminution in resistance.

2. The critical point in the various resistance curves occurs at different pressures for different brushes.

3. The contact resistance of carbon is much higher than that of copper.

4. The contact resistance of all brushes is less on a cast iron pulley than on a copper commutator.

5. Slightly oiling the cylindrical surface only slightly increases the contact resistance.

6. The tangential pull due to friction is directly proportional to the pressure on the brush.

7. Slightly oiling the cylindrical surface greatly diminishes the friction.

8. For the same brush the friction is less on cast-iron pulley than on a copper commutator.

9. The friction of a copper brush is greater than that of a carbon brush at the same pressure.

10. The friction of a radial carbon brush is greater than that of a tangential carbon brush at the same pressure.

11. The friction of all brushes is slightly less at high than at low peripheral speeds.

The most advantageous pressure at which to work any

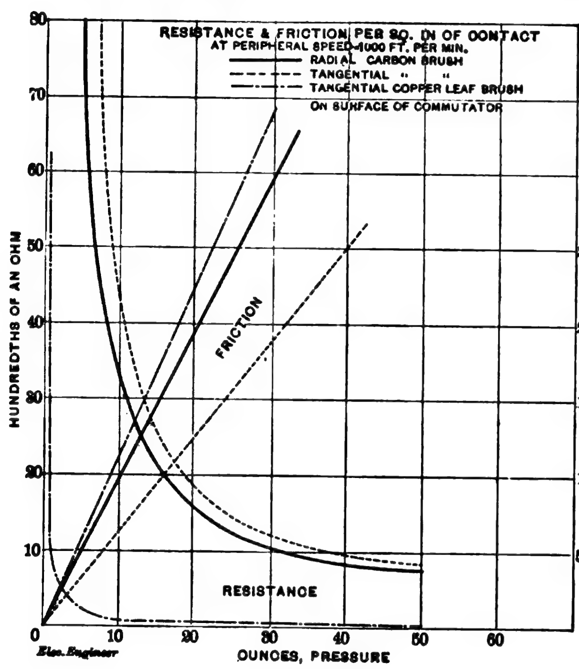


FIG. 7.

given brush will depend largely upon the relations existing at the different pressures between the loss of electrical energy due to ohmic resistance and the mechanical work consumed by the friction of the brush. The former can be found in watts for any point on one of the resistance curves by multiplying the resistance given for that point by the square of the current passing through the brush; and the latter, in horse-power, by multiplying the tangential pull in pounds, due to the friction of the brush, by the peripheral speed in feet per minute and dividing this product by 33,000.

For instance, in Fig. 7, take the resistance of the radial carbon brush at 24 ounces ($1\frac{1}{2}$ lbs.) pressure and assume that 20 amperes are passing through it. The ohmic resistance at this point is .13 ohm which multiplied by 20^2 gives 52 watts $=$ .07 H. P. At this same pressure the tangential pull is found to be 23.5 ounces $=$ 1.47 pounds. This, multiplied by the peripheral speed, 1,000 feet per minute, and divided by 33,000, gives .042 H. P. as the mechanical power lost in friction, being in this case about two-thirds of the electrical loss.

MY EXPERIENCE WITH INTERIOR WORK.

BY

A. E. Dobbs

CONDUIT work, at one time expected to supersede all other forms of wiring, has not in all respects fulfilled the conditions exacted of it. It has led to many improvements in wiring and also to the introduction of some methods that are not at all desirable.

When Mr. E. H. Johnson first introduced his system, he, as a practical man, elaborated it even to very small details under the supposition that his plans would be carried out; which, unfortunately, they were not. The first fault to be found was with the tube itself. It was not strong enough or flexible enough to stand all the rough usage to which it would naturally be subjected. Neither was it waterproof when exposed to dampness. The original single tube system was soon frowned upon by the Fire Underwriters and the double tube system had to be substituted, doubling the cost all round. Then while the price of the tube itself was reasonable enough, the cost of the fittings, elbows, junction boxes, etc., was enough to make a contractor stop and think. Result,—a discarding of most of the fittings and the adoption of the loop system.

Now the weak spots in all wiring systems are the outlets, both as to insulation and resistance. In all my experience I have known but few cases of trouble upon the lines. It has nearly always been either at the outlets or in places where wires were bunched to reach the outlets; and in loop wiring we have four wires to deal with where we formerly had two. The ends of the conduit chafe the wires, if nothing worse, and it often happens that four ends are difficult to dispose of. Again, in moulding or concealed work you could always depend upon finding the joints soldered

In the loop system the ends are not always soldered together by any means. The ends are left hanging until the plasterers get through. Then along comes the fixture man who cuts them off to suit himself and proceeds to connect up his fixtures. He will not solder the connections; that, he contends, being the wireman's work. The wireman throws the responsibility on the fixture man with the result that it is not done at all and the inspector is so anxious to boom conduit work that he never seems to look at the outlets. Thus we see that the loop system may not only greatly increase the distance between some lamps and the centre of distribution, but that bad joints may cause quite a perceptible falling off in candle power in the more distant groups of lamps.

But in spite of all this, the conduit system proved a good thing. It protected the rubber insulation of the wire in a great measure from the surrounding air, insuring longer life. The tube itself was a good insulator under all ordinary conditions, thus affording double protection against leaks; and lastly mice and vermin let it alone, an important point where rubber insulation is insisted upon.

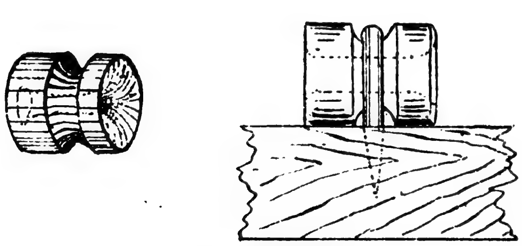
Of course the Interior Conduit & Insulation Co. soon had rivals in their particular field, and we quickly had several kinds of tube, among which Vulca, and the American Circular Loom have become the most prominent. Vulca tubing is a good insulator, an excellent substitute for hard rubber, and is not apparently affected by dampness, but it is so very brittle that it has to be handled with great care, and its low cost is offset by the extra time and care required in handling it. If a piece falls on the floor it breaks. A contractor must, therefore, buy considerably more than he actually needs, and if after the conduit is in place a piece should become broken, as often happens, is that piece taken down and replaced? Well, hardly; that would often mean taking down a hundred feet of conduit.

It is said that mice sometimes attack this tubing but I have never seen a case of that kind. It is easy to fish

through, having a hard smooth surface on the inside. But there is not a great deal of fishing done in conduit work. Fishing is impracticable in a great many cases owing to the length of the lines, numerous angles, etc.; besides, men who take contracts are not willing to do two or three days' extra work, to say nothing of the fact that larger tubing would be required, adding still more to the expense, the original idea of using a single tube and very thin insulation having to be abandoned. Specifications and rules calling for fished work are calmly ignored and plasterers find the wires hanging in their way as they did in the days before conduit was brought out. The Fire Underwriters are largely responsible for this in forbidding the use of strings for drawing in the wires. Doubtless they wanted to make sure of a continuous conduit, but I cannot see how they are any more sure of it under the present methods. And as to pulling wires out and renewing them without breaking the tubing; well it *may* be done *in some cases.*

So much for plain unarmored conduits. Almost simultaneously came "brass armored" and American Circular Loom conduits. There was not the least doubt about the brass armored conduit being a decided improvement over all previous kinds. But the Underwriters still objected to the single tube, twin wire system, so that while the cost was greatly increased, the contractor received but a small portion of it for his work. Moisture would get into it when the walls were freshly plastered and seemed unable to get out again; and I have seen conduit taken from damp places that was almost pulpy from moisture. Then men will not always take time to crimp the joints; besides in many cases it is very troublesome to do so. There is no use in arguing what the system would do if properly installed. The most specific directions and lectures as to the proper mode of installation will not help a careless wireman or alter the financial aspects of the case to the contractor who has been compelled to "figure close" and who tries to save all he can on the labor account.

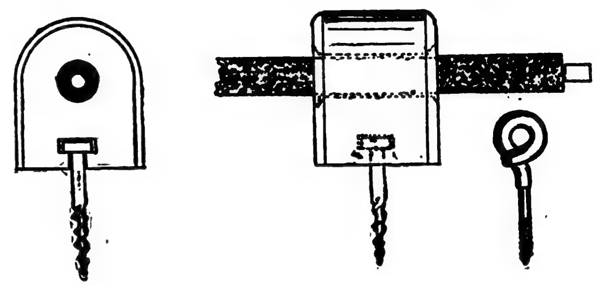
The American Circular Loom sprang into popularity among contractors and insurance men alike from its toughness, flexibility and ease of installation. There are no extras, such as elbows, sleeves, or junction boxes, no special tools to buy and weight down the tool bag; its inside surface is smooth, making it easy to push wire into it; if crushed, it can be straightened out. A wireman can run three or four hundred feet of it while getting ready to run any other kind; so that notwithstanding its comparatively high price it is found for small installations at least to be as cheap as, if not cheaper than, any other. Of course it would not do in very damp places and where you had to look out for cement, but that seems the only objection



FIGS. 1 AND 2.

to it. Both "brass armored" and "Circular Loom" conduits had their partisans among engineers, contractors and inspectors.

The Interior Conduit people, however settled the matter by bringing out their now famous iron armored conduit, which is undoubtedly the best thing yet in conduit work. As this conduit can be installed on the single tube plan the cost of material is but slightly more than the brass armored or flexible. The cost of labor will be somewhat greater, and the wireman has to buy about twenty-five dollars' worth of tools to get started in this kind of work. Another tube lately brought out consists of flexible hard rubber sheathed by lead armor, thus protecting it from the air and dampness. It seems to me almost as flexible as the Circular Loom and possesses the advantage of being moisture proof; the inside is as smooth and hard as Vulca making wiring easy. The price is about the same as the Circular Loom. The Underwriters, however, have never to my knowledge, endorsed it, though I cannot see why not. Still I have never had any experience with it, and it may develop faults not apparent from an examination of samples. I should think it would have to



FIGS. 3, 4 AND 5.

be handled with considerable care, and it might be easily crushed.

Now for another system or rather a modification of an old system. Outside of our largest cities the majority of houses in this country are built of wood, or at least with lath and plaster walls so constructed as to leave plenty of space inside the lath for wires, and the demand in such houses is for cheap and safe wiring. As to wire. If one can get the local inspector to agree to it, what is commonly known as weather proof wire triple braided can be used. While this wire will not stand the laboratory tests of rubber insulated wire, it will last longer in dry places. I have seen so much rubber wire get hard and crack after four or five years' use that I have very little confidence in it for this class of work; while I have seen "K K" wire exposed for years to the trying conditions of overhead work in New York city apparently as good as ever, except that the outside braid showed some effects of the weather.

In ordinary cases wires are not called upon to meet the tests laid down by the Board of Underwriters. They do not have to carry current under water; they do not get soaked in lime water, and they do not carry 500 volts. On the contrary they are generally so run that if the wire were bare it would still be safe and it is well to remember that mice let all asphaltum compounds alone. When threading between joists and partitions, I generally use the ordinary porcelain circuit breakers and staple, or tie them to the joists or studding, Figs. 1 and 2, and draw the wires through from outlet to outlet as in the conduit system. When going through joists I use porcelain bushings; they are nearly as cheap as any other, and I have them large enough for the wire to pull through easily or if there is a long run one can use flexible conduit tied to the ceiling between the lath and avoid boring holes. At the outlets I use porcelain tubes with at least a ⅜ inch hole and pull both wires belonging to the same loop through one tube; this prevents the wires getting mixed and saves testing everything to match the ends. In case any other tube is used for the outlet than porcelain, such as Vulca or hard rubber tubes, at least ½ inch in size should be used.

Figs. 3 and 4 show an insulation which would be good for this kind of work and which ought to be sold for about $30 per thousand. It is made of porcelain with a screw in the bottom which may be moulded in the insulator or afterwards set in with lead. I have never seen exactly such an insulator on the market; it probably is not manufactured, and manufacturers are welcome to the idea. The

nearest approach to it is the Fletcher insulators which are made in several parts, are not so strong, are high priced and not nearly as good. Another resembles it in having a hole in the top but it takes two screws in the base. Fig. 5 shows the Seely pigtail insulator which would be simple, cheap and good if the insulation could be made of porcelain instead of hard rubber. Mr. Seely is welcome to this suggestion also. Both insulators Figs. 3 and 5 could be turned in by hand and thus lighten the burden of profanity upon the wireman who has to work a ten inch screw driver in a six inch space.

A job of this kind will satisfy customers, satisfy the inspectors, and enable one to make some money on the contract. And, where a regular conduit job is called for, one should work in iron armored conduit if one can; if not, the flexible kind is to be preferred.

ROUNDABOUT NOTES IN ELECTRICAL EUROPE.—I.

STREET CAR TRAVEL IN ANTWERP.

BY

E. J. Wessels.

It is a surprise to find that electricity in Antwerp has not been utilized for light and traction to anything like the extent it has been used in many smaller cities. The traveler who studies the shop windows observes that gas and the Welsbach light are to be seen in many places, while the incandescent light is not so largely used.

In the Banque d'Anvers there are a dozen Welsbach burners to one incandescent lamp and the latter cannnot be said to give as satisfactory results as the former. To one accustomed to the brilliant electrical displays in the streets of New York, there is a feeling of disappointment over the dimly lighted streets of this old city. Antwerp is a place of surprises owing to the marked contrast it presents alongside of our American seaboard cities. For a city of at least 240,000 inhabitants, it possesses poor facilities for handling traffic. The electric motor here is quite unfamiliar. One looks in vain for motor cars and trailers.

The old time slow horse car still holds sway and seems to satisfy the public. When asked why electricity isn't used, the average man replies "We don't do things so fast here. We go slow and sure." One of the book stores has in its window an illustration of an accident to a trolley car, in which numerous passengers are shown in all stages of injury and fright. The people look on and remain satisfied. They prefer to have their neighbors use electricity meanwhile, but it is only a question of time when the electric motor will come here to stay.

It is curious to observe the open cars running here. They are 14 to 16 feet long, have eight seats and when fully loaded hold but few passengers. Perhaps the most peculiar thing about them is the low foot (or running) board. These foot boards are suspended by cross braces and only have a clearance of an inch and a half, being nearly even with the pavement. There is no danger of turning an ankle or being thrown when entering, or alighting from, the car.

The driver is in uniform, likewise the conductor, and they resemble soldiers, minus guns. Some of the cars start when the conductor's whistle is blown, but others are started by the blowing of a horn. There is not much adherence to schedule, as it is a sort of "Go as you please." There are cars enough for present demands, as the people are inclined to walk. They haven't been educated to ride. Fares are low and for 10 centimes (2 c.) one may travel a considerable distance. The open cars are mounted on single trucks and the wheels rise above the floor over a foot. This trips the passengers and is most objectionable. The ordinary hand brake is used and closely resembles the American type. As this part of Belgium is very flat, there are no grades. A tee rail is used in many places and the rest is a girder rail such as your readers are familiar with. Single track with turnouts will be found, although in certain districts there is a double track. The paving is good and mostly the well-known Belgian block. Wood is scarce and the telegraph poles are of iron, raised considerably above the low houses. In numerous places the track, instead of being at the side or in the middle of the street, runs diagonally across and very near the curb. It often happens that when a sharp turn is made, the rear end swings around and brushes against the sidewalk pedestrians. They take it good-naturedly and seem to expect such a result. When fares are collected the conductor issues a printed receipt therefor. Advertisements are few and are on the sides above the roof. Instead of several, there usually is but one in large white letters on a blue background.

There are several lines, the Tramways Maritimes and Nationaux leading to the quays and prominent stores and parks. There is an omnibus company which operates the 'busses and also a company which controls carettes such as abound in Philadelphia, with the exception that one horse here hauls a load that two or three are required to handle in America.

It is unlikely that the great electrical companies on the Continent will rest content with equipping systems elsewhere. They must sooner or later get an entrance into this ancient town and there is likely to be a good field. Operating expenses will be light, as coal can be landed cheaply. When the electric light comes into greater use there will be profit in central stations for furnishing light and power under one roof.

THE ELECTRICAL PROPERTIES OF SELENIUM.

In a paper read before the London Physical Society Mr. Shelford Bidwell gives the following conclusions as the results of his investigations:—(1) The conductivity of crystalline selenium appears to depend principally on the impurities which it contains in the form of metallic selenides. It may be that the selenides conduct electrolytically, and that the influence of light in increasing the conductivity is to be attributed to its property of facilitating the combination of selenium with metals in contact with it. (2) A selenium cell having platinum electrodes, and made with selenium, to which about 3 per cent. of cuprous selenide has been added, is, even though unannealed, greatly superior, both in conductivity and sensitiveness, to a similar cell made with ordinary selenium and annealed for several hours. (3) Red selenium in contact with copper or brass is quickly darkened by the actions of light, owing, it is suggested, to the formation of a selenide. (4) Crystalline selenium is porous, and absorbs moisture from the air, and it is this moisture that causes the polarization of selenium after the passage of a current. (5) The presence of moisture is not essential to sensitiveness, but appears to be in a slight degree favorable to it. (6) If cuprous selenide is made the cathode in an electrolytic cell, and a strip of platinum the anode in water, red selenium, mixed with detached particles of the selenide, is deposited in the water. (7) The photo-electric currents, sometimes set up when light falls upon selenium, are dependent upon the presence of moisture, and are no doubt of voltaic origin. (8) Perfectly dry selenium is below platinum in the thermo-electric series.

ELECTRIC TRANSPORTATION DEPARTMENT.

THE DEY-GRISWOLD HYDRAULIC GEARING FOR ELECTRIC CARS.

The economy to be attained by a motor run continuously at constant speed in electric railway work has given rise to a number of devices in the way of gearing to make this possible; and among these the hydraulic gear has received some attention. More recently Mr. Harry E. Dey, of the Dey-Griswold Co., has devoted his attention to this subject and his work is embodied in the new hydraulic gear and motor arrangement illustrated in the accompanying engravings.

In the Dey system, the single motor used is suspended by springs at the centre of the truck. Both field and armature revolve, the former having ten poles, but only one coil, and being shunt wound. The armature is series drum wound, the coils being wound on a lathe and slipped over the teeth on the inner surface of the cylinder. Four brushes are used. These bear on the end of the commutator for the prevention of the unequal pressure caused by centrifugal force. The spider extends out over the brushes and protects all parts from dust. Slides provide for the inspection of brushes, etc.

The armature and the field have separate shafts, and on each of these is placed a pump having four cylinders arranged radially, as shown in Fig. 1. The pistons are single-acting and all four are attached in the same plane to one crank-pin by adjustable rings A A, Fig. 2. This crank-pin may be said to be the key to the whole problem. It is adjustable while in motion, moving 1½ inches either side of the centre. This gives a variable pumping capacity from maximum to zero in one direction, and from zero up to maximum in the opposite direction, without steps or reversing valves.

On the axles are placed what are known as the gear type of fluid motors, Fig. 3. Flexible pipes connect these with the pumps which are arranged in series with the fluid motors,—pumps and motors alternating. The pipes, pumps, and fluid motors are filled with oil. It is evident that when the pumps are operated, they will force the oil through the pipes to the fluid motors on the axles and cause them to revolve. The greater the capacity of the pumps, the greater will be the speed of the car; and the axle motor will in turn act as a pump and drive the pumps themselves as fluid motors, and the motor as a dynamo whenever mechanical power is applied to the axles as in the case of descending grades, etc. It is also apparent that when the crank-pin is at the centre, the pistons will be held rigid, and it would then be utterly impossible for the wheels to turn, although the motor be running continuously. If the pin is moved from the centre, one-sixteenth of an inch, for example, a stroke of one-eighth inch will be produced. The motor would then have an immense leverage or torque for starting, as the ratio of reduction would be twenty-four times as high as at maximum speed. To this would be added the fly-wheel capacity of the continuously revolving field and armature. There is, therefore, absolutely no danger of ever being stalled when it is possible to get a grip on the rails. Besides this, as the whole apparatus is piped in series, if one set of wheels is inclined to slip, the power is applied to the other axle; that is, both axles are practically geared together.

As the crank-pin is moved further from the centre, it increases the length of the stroke, and, consequently, the pumping capacity and speed of the car. If the pin be moved back, the axle will immediately have to decrease its speed, or the pump and electric motor increase theirs. An increase in the motor will instantly convert it into a dynamo as the counter E. M. F. will overcome the applied E. M. F. This would act as the best of electric brakes until the car comes to its proper speed. If the pin be carried past the centre, it will reverse the direction of the flow of oil to the axles, because of the change in the relative positions of the valve B and the pin. This would immediately start the wheels revolving in a direction opposite to that of the car. There are only two valves in the whole apparatus,—one on each pump,—and they are entirely automatic. The construction is simple, there being one casting with two plain ports keyed to the shaft.

The governing of the crank-pin is as follows: The crank-pin and the beveled plates D and E form practically one piece. Though made in two parts, one part threads into the other. These plates slide in the dove-tailed grooves of plates F and G. Plate E has a rack which meshes with the pinion H; the latter is keyed to shaft I which has four parallel high pitch threads cut upon it. The nut J threads on these, and also slides in a groove in K which is an extension of the main shaft, with which all of these parts revolve. L is normally a stationary nut threaded on the

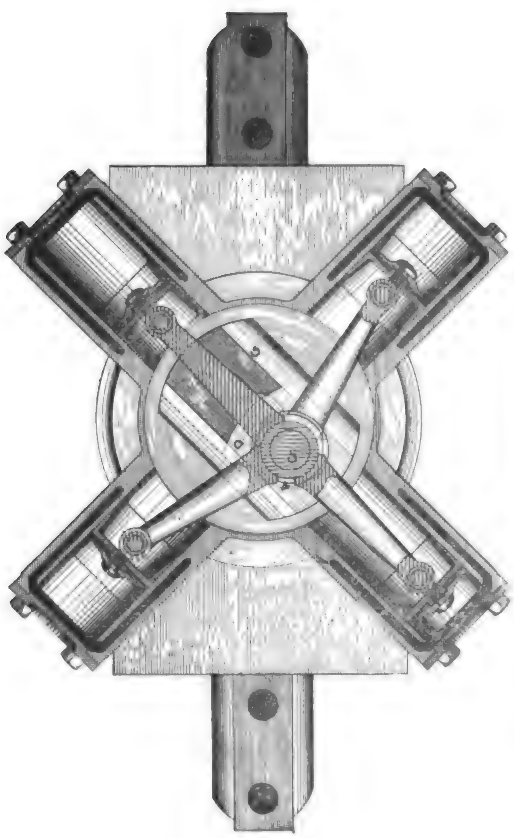


Fig. 1.—Section Through Pump.

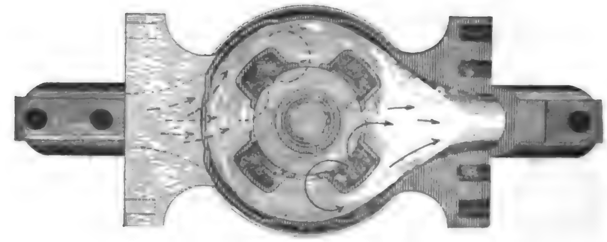


Fig. 4.—Section Through Valve.

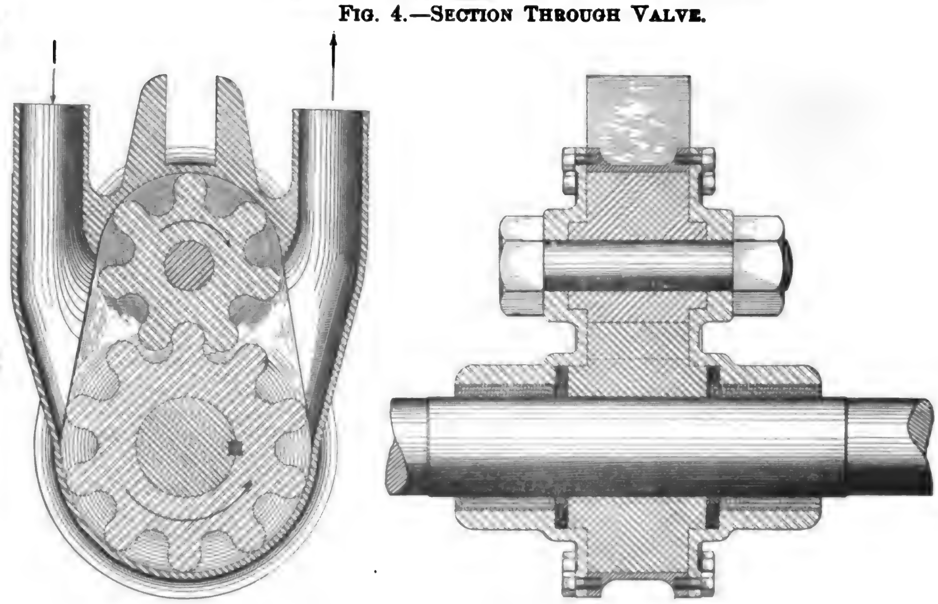


Fig. 3.—Sections of Fluid Motor on Car Axle.

outside and having the nut J freely revolving inside of it. These keep their relative positions by means of the collar shown. Working in the thread of nut L is the sprocket nut M which is connected by a chain to a sprocket and crank-handle on the platform. The turning of this handle turns the nut M which draws L in or out. This in turn draws K in or out, revolving I and H to move the crank pin. It will be seen that in any position the crank pin is locked.

The fluid motor will be readily understood by an inspection of

Some of the advantages claimed for this system are: A very high efficiency, saving in many cases 50 per cent. of the current. The largest saving would be made on streets like Broadway, New York, where the stops and starts are so frequent and the running is so slow; also where there are many hills. In places like Kansas City, St. Paul, and Pittsburg this saving would probably be exceeded. These results are accounted for on these grounds: First, the very high efficiency of a shunt motor, governing the amount of current in almost direct proportion to the mechanical load,

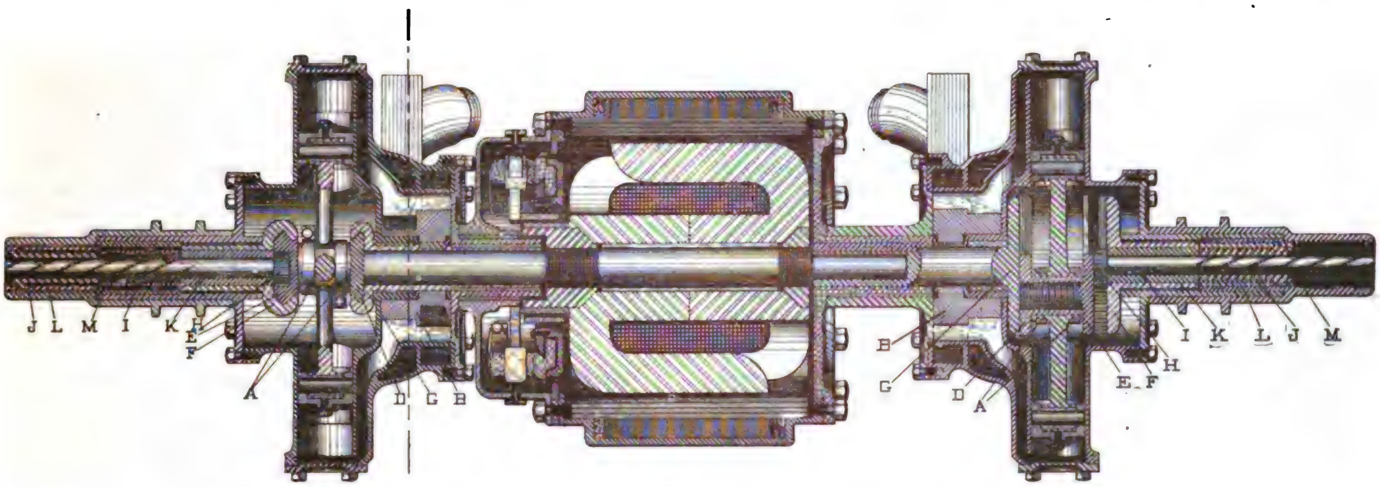


FIG. 2.—DEY-GRISWOLD SYSTEM.—SECTION THROUGH ELECTRIC MOTOR AND PUMPS.

Fig. 3. The direction of the arrows should be carefully noted. Fig. 4 shows a section through the valve.

It is a well known fact that several times the requisite motive power is placed on a car in order to obtain the necessary torque to start, for the rated horse-power is not delivered until regular speed is reached. Take, for example, a motor designed to run at 600 revolutions and furnish 20 horse-power. In starting up, a speed of 6 revolutions delivers only $\frac{1}{100}$ of 20 or $\frac{1}{5}$ horse-power, unless overloaded. The shunt motor described, always running

instead of wasting it in resistances or over-saturated field coils. Second, the large percentage returned to the line on down grades or whenever overcoming the momentum of the car; on the Brooklyn bridge it is claimed the amount returned to the line would be just 33 per cent. of the total current required. Third, a reduction of one and a quarter tons in weight, because there is only one 20 horse-power motor whose weight is only half that of the usual type of motor of the same power, on account of the revolving field and armature. Practically, the weight of one and

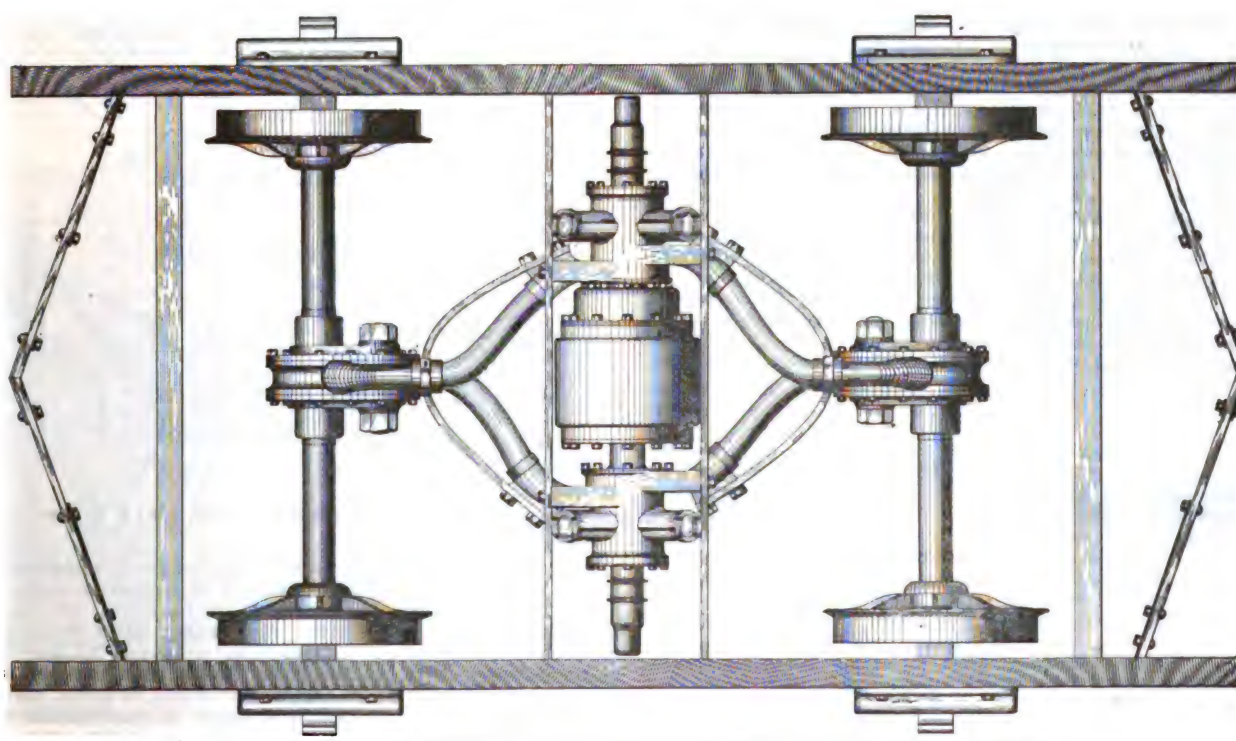


FIG. 5.—DEY-GRISWOLD SYSTEM.—PLAN VIEW OF MOTOR AND HYDRAULIC MECHANISM.

at a constant speed, will always deliver its rated power, and, if necessary, triple it for a short time.

Fig. 5 shows a plan of the motor and pump mounted on the truck.

The company proposes to build a 20 horse-power outfit to begin with, and will experiment downward, expecting to stop at about 10 horse-power. Twenty-four inch car wheels will be used. The 20 horse-power motor has an outside diameter of 17 inches.

one-half motors, or 3,000 pounds, is dispensed with; against this comes the weight of the pumps, 350 pounds. The fluid motors counterbalance the weight of gears which they displace. The cumbersome controllers, rheostats, and brakes are also unnecessary. The revolution of both field and armature also adds a small gain in efficiency, the $C^2 R$ loss being divided by two, approximately. If a fifty per cent. saving is made in coal, it follows that a corresponding saving is made in cost of power-house, feed

wires, and many other minor items. The car is under absolute control with one handle. It can be started very quickly, yet easily, and stopped much more readily than with hand or air brakes. The braking begins simultaneously with the beginning of the movement of the handle. A fraction of a second so saved would, in many cases, have prevented loss of life in the past. The motor is spring mounted, and the inertia blow of axle-mounted motors is prevented.

By using a synchronous motor, the alternating current would be available, and the problem of utilizing the alternating current for railway purposes, it is believed, be practically solved.

When used on trains, a fluid motor can be placed on each axle throughout the train, utilizing the traction of all. This would permit very quick starting and stopping without jerks. A broken coupling-pin would be unknown; indeed, coupling-pins could almost be dispensed with entirely.

As a financial competitor, this system, it is claimed, can readily hold its own. About sixty per cent. of the motor cost is saved, and the expensive controllers, rheostats, and hand or air brakes are not required.

The motor may be built for any desired maximum speed, beyond which it would be impossible for the motorman to run it, regardless of down grades, etc. If, however, the chief engineer should wish to increase that speed, he may do so indefinitely by placing a small resistance in the field circuit. There is no danger from burnouts as the motor is never started with a load. The brushes and the commutator will last longer, because they may be placed with their proper lead. The car floor will be very low, and there will be very little noise aside from the hum of the brushes.

Mr. Dey also claims that this system affords the best of brakes, disposes of the separate brake handle, and provides a dynamo, a reverser, a governor and other adjuncts without adding a single piece of mechanism.

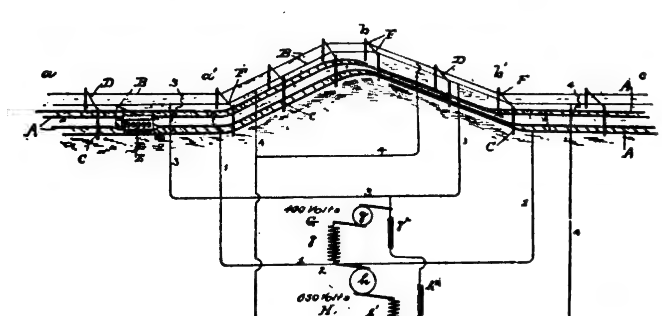
The Dey-Griswold Co. has been recently incorporated, with offices at 108 Fulton street, this city. Harry E. Dey is president and general manager; Fred. B. Griswold, vice-president; W. C. Thacher, secretary and treasurer; and Charles A. Gaines, superintendent. The directors include the above named and Mr. Franz Nemo Roehrich. The company will do a general electrical manufacturing business including the system described above, and modifications for elevators and electric carriages. They are also developing an induction system for street-cars which has a complete magnetic circuit.

THE HENRY COMBINED THREE-WIRE AND BOOSTER SYSTEM FOR ELECTRIC RAILWAYS.

Where heavy grades exist on the routes of electric railways, or where congested traffic throws a heavy load on a particular portion of the system, special heavy feeders are now provided and it has been proposed to reduce the expense of these by employing boosters, or auxiliary machines to supply the heavily loaded section with an increased potential.

To accomplish the same object but without the use of an extra generator, Mr. John C. Henry has devised a system consisting of a three-wire circuit fed by two generators of different constant potential, the line being divided into insulated sections, each of which is connected with that one of the generators which produces the potential suitable for that section. The rails of the track form the neutral conductor.

The portion of road shown in the accompanying diagram is



Henry's Combined 3-Wire and Booster Railway System.

supposed to be divided into sections requiring different voltages. The section from a to a' is a congested part of the city, where the cars E must run slowly. The section from a' to b is an up and down grade; that from b to b', a down and up grade; that from b' to c, a suburban district where the cars may run rapidly. On the sections where it is desired to run slowly the maximum voltage is fixed at, say, four hundred, and this may be the voltage, also, on all downgrades. On the upgrades and also in the suburban portions the voltage is arranged at six hundred and fifty. The sections of the working conductors on which these different voltages are used are electrically separated by insulating connectors F.

Current is supplied to this system by two constant potential generators G H, the former giving a voltage of four hundred and the latter of six hundred and fifty. These machines are compound wound, the armature g h and series-coils g' h' being connected in series, and the shunt-coils g^2 h^2 being also connected in series, forming a single shunt for the two machines. The neutral conductor 1 is connected with the series-field-coil circuit between the two machines at 2, and also with the rails of the track A, which are electrically continuous. The positive brush of the dynamo G is connected by the feeders 3 with those sections of the working conductor on which a potential of four hundred volts is to be maintained, while the negative brush of the dynamo H is connected by the feeders 4 with those sections of the line on which the potential is to be six hundred and fifty.

It will be seen that this system operates substantially in the same manner as a three-wire system of the usual construction, and that it also supplies different portions of the line with different voltages without the use of an auxiliary dynamo. The peculiar connection of the shunt-coils is of especial importance, and has been found to be essential where constant potential dynamos of different voltages are connected together in series.

WIGHTMAN'S STREET RAILWAY MOTOR.

It is generally acknowledged that the introduction of the series-parallel controller for regulating street railways was one of the most important advances in the art and has resulted in a marked economy of current consumption. This method is of course confined to cases where double motor equipments are

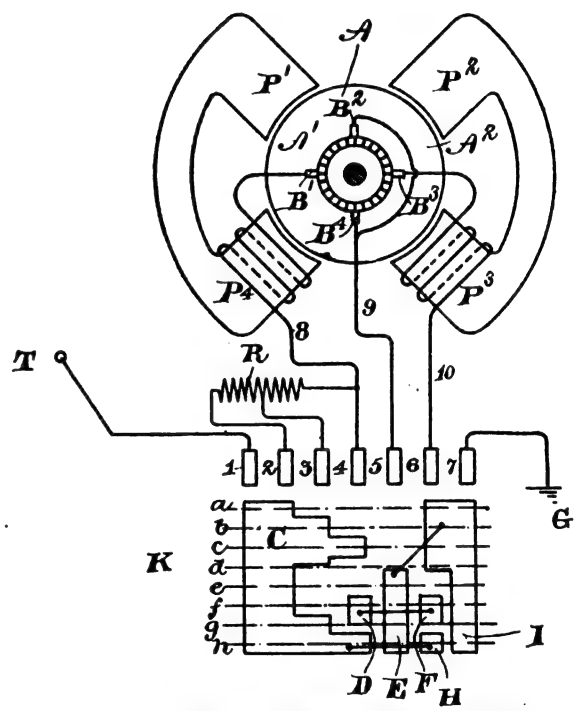


Fig. 1.—Wightman's Street Railway Motor.

used, but single equipments are still called for in some cases and with a view to affording a like method of regulation on a single motor car, Mr. Merle J. Wightman, of Scranton, who has done much original work in electric railroading, has devised a most ingenious arrangement. The method employed by Mr. Wightman consists in first operating the motor as a two-pole motor with the two halves of its armature running in series, and then, by the interposition of suitable resistance in combination with a shunt around one-half of the motor, changing this arrangement to one in which the motor operates as a four-pole motor with the two halves of its armature in multiple.

The accompanying illustration, Fig. 1 shows the arrangement diagrammatically. A^1 A^2 are the two halves of the armature; B^1 B^2 are the two brushes which are always active and B^3 B^4 those used as negative brushes when the motor is operated as a four-pole machine.

P^1 to P^4 are the field magnet poles, two of which are wound poles and two unwound or consequent poles. The direction of winding upon the poles P^3 P^4 is such that when the current passes in

series through the two halves of the armature, both of these poles are magnetized in the same sense, either north or south. The two upper poles P^1 P^2 are then of consequent and opposite polarity to the two lower ones. When the current, however, is reversed in the pole P^3, this pole becomes of opposite polarity to P^4, and the four poles then alternate in polarity around the armature, converting the machine into a four-pole motor. At this time the brushes B^3 B^4 become active, having been open-circuited before. A resistance R is provided and furnishes further means of regulating the speed and torque as well as preventing undue sparking incident to the changes of connections.

K is the controller, the cylindrical contacts of which are shown

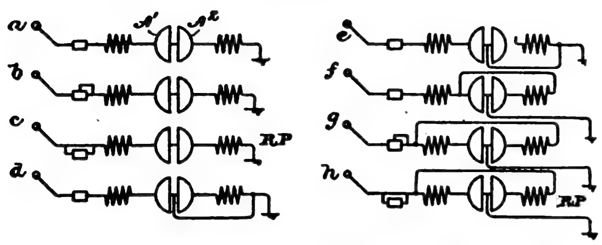


FIG. 2.—CONNECTIONS OF WIGHTMAN REGULATOR.

developed in plane. The controller is provided with contacts C, D, E, F, H, and I, and with cross-connections, and also with fixed contacts or brushes 1 to 7. The dotted lines represent the different working positions of the controller corresponding to the diagrams *a* to *h* in Fig. 2. In the latter diagram the positions marked R P indicate running positions, the others only being used while the motor is changing its speed.

COAL-HANDLING MACHINERY IN ELECTRICAL PLANTS.

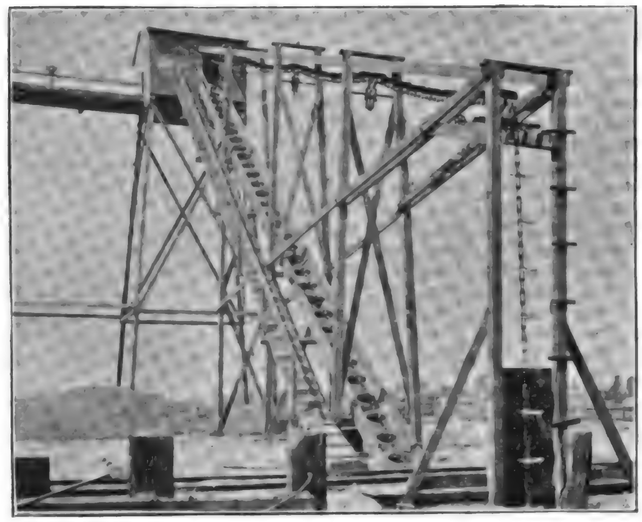
THE development of electric power for the operation of railways, as well as for use in industrial plants all over the country, has called for the installation of many large power houses, in which the consumption of fuel for the production of electricity is concentrated. In nearly all cases large units of power being employed and the growing tendency being toward even larger, the designing of these power plants involves, as a very important consideration, the most economical method of handling coal in large quantities between the carts, cars or boats and the boiler room floor. The cost of handling fuel in large quantities has become quite an item in the operating expenses of power plants, and labor-saving machinery for this purpose has consequently received a great deal of careful study by mechanical engineers. Many of the largest equipments of this class have been designed and erected by The Link-Belt Engineering Co., of Nicetown, Philadelphia, and among them that of the Hestonville, Mantua & Fairmount Park Passenger Railway Co., of Philadelphia, which, as it differs from other power plants in that city, by receiving its coal from boats, we have selected for illustration in this issue

COAL CONVEYER, HESTONVILLE, MANTUA & FAIRMOUNT PARK R. R., PHILADELPHIA, PA.

The road itself was very fully illustrated and described in THE ELECTRICAL ENGINEER of January 9, 1895.

The power plant is situated upon the Schuylkill River front, about 100 feet back from the pier line. The coal, brought to the wharf by canal boat, is automatically conveyed to the storage bin, which extends the entire length of the boiler house and has a capacity of 300 tons. From this bin the coal is tapped by chutes, which deliver it directly in front of the boilers.

The machinery employed for the coal-handling consists of a dock-leg elevator, inclined conveyer and horizontal conveyer,



COAL CONVEYER, WELLMAN IRON AND STEEL CO., THURLOW, PA.

which operate as follows: The elevator, suspended at the end of a boom, consists of two strands of Ewart link-belting, to which strong buckets are bolted, the whole being housed in a wooden casing and arranged for raising and lowering as may be required. The coal after being elevated to a proper height is discharged into a chute, which by gravity delivers it into the foot of an inclined trough, in which a scraping conveyor works. By this conveyer it is carried to the top of the incline and at that point delivered into a short chute, which feeds into a horizontal trough extending over the top and entire length of the storage bin. In this horizontal trough, a scraping conveyer also works. The discharging from this horizontal trough into the storage bin is effected by means of a number of gates in the trough bottom, which latter can be opened and closed by small hand wheels. In both of these conveyers the well known "Dodge" chain is used. The troughs are of the standard form always employed in this kind of work and are made up of sections of wrought-iron with depressed lap-joints, thus insuring a continuously smooth trough; and as the flights are provided with wearing shoes, the working of the conveyer is attended with but little noise. On the inclined conveyer the supporting of the return chain is effected by a continuous guide consisting of two angle-irons supported over the entire length of trough and upon which the flights slide, the latter being at their edges also fitted with wearing shoes. This construction contributes to smooth running and reduces the wear on the chain.

The accompanying illustration shows clearly the driving gear. The entire machinery is driven by a small vertical engine, which is located upon the floor of the power house and below the head of the inclined conveyer. The power is transmitted through an 8 inch belt to a countershaft, which carries a "Link-Belt" disc friction clutch and a spur pinion, which latter drives a spur gear, upon whose shaft are also fixed the driving sprocket wheels of the inclined conveyer and horizontal conveyor. Thus the pull on the inclined conveyer is at the delivery end of the loaded chain. The friction clutch is so arranged as to act upon the spur pinion, and hence makes it possible to run the machinery independently of the conveyors.

The power necessary for driving the elevator is taken from a rope sheave located upon the countershaft referred to above and transmitted by means of a manilla rope to a similar sized sheave located in the dock-leg tower. The shaft of this latter sheave carries a spur pinion, which, by means of an intermediate wheel, drives a spur wheel, upon whose shaft is a Ewart sprocket wheel. From this Ewart sprocket wheel the necessary power for driving the elevator is transmitted through a No. 88 chain to the head shaft of the elevator. The intermediate wheel just referred to, driven by the spur pinion, has upon its shaft a sprocket wheel which, by means of a No. 88 Ewart chain, drives a spur

pinion and wheel, upon whose latter shaft is a drum. Upon this drum the crane chain is wound which supports the dock-leg elevator, so that the raising or lowering of the elevator is effected by the revolving of the drum, and its motion is given to it through a "Link-Belt" disc friction clutch.

This plant was designed to provide for the handling of 40 tons of coal per hour, which it easily accomplishes. In all of this machinery, the capacity has a large margin, so that it can always be increased by a slight acceleration in the speed at which it operates, without unduly taxing the driving gear. The power required for this plant is comparatively small, and, with the exception of the small amount of handling required to feed the coal into the foot of the elevator, is entirely automatic and shows such good results as to forcibly suggest the adoption of similar systems elsewhere.

Another plant for the storage of coal which has attracted considerable attention, is one which was also constructed by The Link-Belt Engineering Co. for the Wellman Iron & Steel Co., of Thurlow, Pa. This will handle upwards of 40 tons per hour, and although somewhat similar to the one described above, presents some features not included in the foregoing. In most cases the power required to drive this machinery is furnished either by an independent engine or from a countershaft, but here an electric motor is used, which adds one more to the many uses to which these motors have been put. The use of an electric motor in this case presented advantages over a small steam engine, inasmuch as it is placed on the top of the tower, which is at some distance from the steam plant and does not involve the loss attendant upon condensation in long steam pipes. The motor was furnished and installed by the Wellman Co., and makes 500 turns per minute.

The view here given shows the inclined conveyer and head, or driving end, of the horizontal conveyer. The system employed is covered by patents controlled by The Link-Belt Engineering Co. and is a simple one. From the time the car is run over the hopper, into which it is unloaded, until the coal is stored there is no shovelling whatever. The plant consists of an inclined trough and a horizontal distributing trough, in both of which scraping conveyers work, operated by means of Dodge chain.

The system of storing is effected in the following manner: Beneath the entering track there is a hopper, into which the cars are dumped. By referring to the accompanying cut it will be seen that the inclined conveyer runs under the tracks and below the hopper, its foot wheel being located just below the bottom of the hopper. A discharge door in the bottom of the hopper delivers the coal by gravity into the foot of the inclined conveyer that leads to the head of a horizontal conveyer. The chain then starting with its load at the bottom of the hopper between the rails, carries it up the trough to the top of the incline and there discharges it into a chute, which in turn delivers it into the horizontal distributing conveyer. This latter conveyer is 100 feet long and the coal is discharged from it through doors located at intervals of ten feet throughout its length. Its trough is supported upon wooden framing at a distance of 35 feet from the ground. Starting at the foot of the incline, under the hopper, the chain moves to the top of the incline, returns over the bends, by passing over idle pulleys, and thence travels in a vertical direction back to the foot of the incline. The return chain of the horizontal conveyer is supported by similar idle pulleys.

The power required for driving the conveyers is transmitted from the motor through a train of gear wheels consisting of two spur pinions and wheels and a bevel pinion and wheel, the bevel pinion and wheel driving the head wheel of the inclined conveyer. All of the driving gear is at the top of the framing of the inclined conveyer, where the electric motor is also located, and as the driving sprocket wheel of the inclined conveyer is at the head of the incline, the pull is at the delivery end of the chain. The troughs are of the standard form and constructed of wrought-iron with lap joints.

TROLLEY CAR BUSINESS IN ST. LOUIS.

Notwithstanding the increase in bicycle riding here, says a St. Louis paper, our street car companies continue to do an immense business. Their reports for the second quarter of the year show a total of 26,826,083 passengers carried in the three months, as compared with 24,778,660 in the corresponding period of last year. This is an increase of over 8 per cent. One company gained over a million passengers, and another nearly a million. Each, however, operates several lines. The largest gain in percentage was made by the Broadway cable road's extension, the old bobtail, double-fare, mule line from Lowell to Baden. It is operated now with electricity, and in connection with the Broadway cable road, passengers being transferred from one to the other without extra charge. The worst showing of all is that of the Jefferson avenue line. Instead of increasing its business, it lost 57,000 passengers. Fortunately for the company's receipts, this horse car line—the only one in the city—is now being converted into a first-class electric road. Its patronage, too, will be doubled as soon as the change is made.

CAN LIGHTNING RUN TROLLEY CARS?

The following story which we reproduce in all the effulgence of the reporter's vocabulary emanates from Norwich, Conn.—

"The latest prank performed by Nutmeg lightning was starting motorman Harlow Ladd's trolley car and whizzing it ten rods along the track without any help from the rumbling dynamos that were grinding out refined electricity in the company's works half a mile away. Harlow had reached the end of the Greeneville route, switched the electric current from the motor, and, brass handle bars in hand, stepped across the street upon the side-walk. The trolley was still connected with the wire. Right overhead a big, round thunder cloud, black and threatening, spun slowly about, portentous with muttering thunder. The rest of the firmament was serene and blue, unsullied by a patch of vapor.

"Suddenly the frowning cloud mass was riven by a zigzag shaft of glittering flame that was shot straight downward against the car motor and made it ring like a bronze bell smitten with a hammer. The report, said Motorman Ladd, was far louder and stronger than a pistol shot. Then, with surprise, amounting almost to awe, the motorman beheld his car, impelled by crude electricity from the clouds, shoot forward eight or ten rods along the track. It did not move very rapidly, and by running he overtook and boarded it just before it came to a halt on the rather stiff grade. The bolt had quickly exhausted itself. In the opinion of motormen and other street railroad operatives, the thunderbolt, heavily charged with electricity, acted on the car motor momentarily in precisely the same way as the regular electric current from the company's works.

"In the same storm a trolley car operated by Motorman Ed Ladd, a cousin of Harlow's, was touched up in a similar lively way on Franklin square in this city. The car was in motion at the time. A long, zigzag tongue of flame was shot like a javelin straight through the open car. Luckily there were no passengers aboard. Conductor John Cousins, who was on the rear platform and had his hand on the brass railing, received a considerable shock. Motorman Ladd was still more severely shocked. Most of the bolt went into the platform switchbox with a ringing report."

Admitting that a car standing still was actually set in motion on being struck by lightning, it would be interesting to inquire just to what extent and in what manner the energy of the discharge itself contributed to the movement of the car. Perhaps some of our readers may have some light to throw on the subject.

CUTTING STEAM FARES IN NEW JERSEY.

It is reported that there is to be a decided cut in the suburban rates of the Central Railroad of New Jersey, on account of the loss of business due to the competition of the trolley line from Elizabeth to Newark. It is said also that the business of the company has been injured by the establishment of a trolley route from Bayonne to Jersey City and New York. The rumor was to the effect that the reduction was to be made this week.

PUSHING THE GETTYSBURG RAILROAD PROJECT.

The new electric railroad from Washington across the state of Maryland to Gettysburg, Pa., a distance of seventy-five miles, is now being pushed by a company of Washington capitalists headed by President Frank Brown of the Baltimore Traction Company. The plan includes three important branch lines aside from the main road. The first of these is from Cooksville eastward on the Frederick turnpike to Ellicott City, and thence to Baltimore, a distance of twenty-two miles; the second is from Eldersburgh to Gwynn Oak Park, about an equal distance, and the third branch is from Westminster to Reisterstown, connecting with Baltimore, twenty-eight miles away. "The idea of connecting the nation's capital with the nation's greatest battlefield," says President Brown, "is a splendid one. Encampments and reunions of many military organizations are held there every year, and besides the thousands that go there from Washington now, there would be thousands of others if a direct route could be built which would take passengers through at a good speed at all seasons of the year without causing them the inconvenience of changing cars. The number of Southerners who visit the battlefield is increasing rapidly each year, and the proposed electric line would give them a good route with only one change of cars at Washington. The legal authority under which this network of new railways would be constructed is found in an amended charter granted by the last Legislature of Maryland to the Maryland Immigration and Trust Company of Baltimore, formerly called the Southern Real Estate and Trust Company. The company is given the right "to construct, equip, and operate steam, electric and other railways in this state." The Pennsylvania rights and the county commissioners' permits to use the public turnpikes must be secured, but as the proposed road will furnish means of transportation in a section which has suffered for the lack of such facilities, it is believed that the necessary charters will be secured without difficulty.

TROLLEY PARTIES IN PHILADELPHIA.

The latest "trolley party" in Philadelphia was that organized for the benefit of the German Hospital. It comprised 61 cars loaded with 3,000 people, and then there were 500 left behind. The parade was headed by a car bearing the Gambrinus band.

"THE electric road is bringing down the price and rentals of city residence property. The country is growing at the expense of the city." So says the Annapolis, Md., *Capital.*

THE CAST-WELDED RAILJOINT.

THE results achieved with the cast-welded railjoint seem to have placed this method in considerable favor, due to the fact that the joint so welded is not only held in a viselike grip but also bonded at the same time.

The Falk Manufacturing Company, of Milwaukee, is turning out as rapidly as possible, in its own shops, several duplicate outfits for putting in its so-called "cast-weld" rail joint, as described in the technical journals. One of these outfits, ready for shipment, is illustrated in Fig. 1, for which we are indebted to the *Street Railway Journal*. The portable cupola, as shown on trucks of any of the machines in case of sandy or muddy roads. Each outfit is equipped with three ladles, one or two for use and one for reserve. The cupola handles 8,000 to 9,050 lbs. of metal in one heat, and this makes approximately eighty joints. Two heats are run in one day where the workmen are not interrupted by traffic on the road, it requiring about three hours to run a heat and about an equal length of time for the cupola to cool sufficient for recharging. When work is confined strictly to the night time, after traffic hours, but one heat can be run.

In casting joints, large iron moulds are used. These moulds are in pairs and are heated hot before clamped in place at the joint. In the illustration is shown, back of the cupola truck, an auxiliary

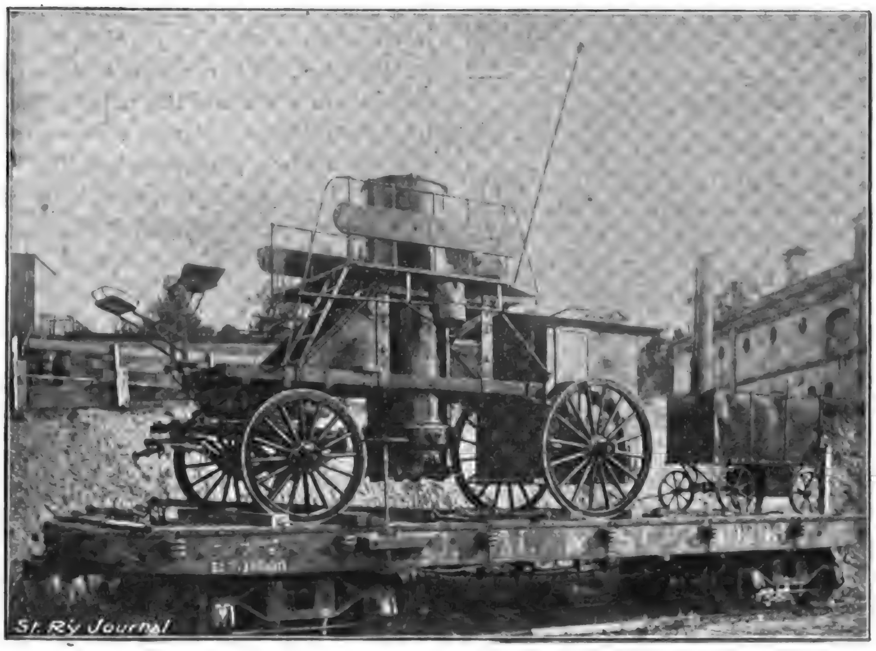


FIG. 1.—PORTABLE CUPOLA AND MOULD HEATER FOR CAST-WELDED RAIL JOINTS.

the car for shipment, is pivotally suspended on the large truck like a mariner's compass, so that it always hangs perpendicular no matter how rough the road may be.

Coke is carried in the box in front of the cupola, and the pig iron for the heat is piled in front of the coke, under the driver's seat and on the platform surrounding the top of the cupola. Mounted on the same truck and back of the cupola is the blower. The blower on the machine illustrated is operated by an electric motor, with a fan on the motor shaft. Power for the motor is conducted from the trolley wire by a regular trolley pole. The outfits heretofore turned out have a steam engine in place of the motor for operating the blower, and the outfits now under construction will also be equipped with engines instead of motors, so that they will be entirely independent of power from a street railway company, and can be used equally as well on cable roads, where there would be no power for an electric motor.

All of these outfits are built standard, with all principal parts interchangeable.

The weight complete before charging is about 12,000 lbs., and they are handled by three horses abreast. The company has sets of wheels having ten inch tread, and which can be used on the outfit, termed the mould heater. This wagon has a fire box below, and has three layers of grates arranged inside the box and on which the moulds are placed for heating. Fig. 2 shows the method of filling the mould and Fig. 3, the complete joint.

It is very natural that many improvements would be suggested as the company progressed with its work. One of the most notable and important of these is a clamp so arranged as to insure a perfectly level and straight joint when welding new rails with the ends abutting.

FIG. 2.—CASTING THE RAIL JOINT.

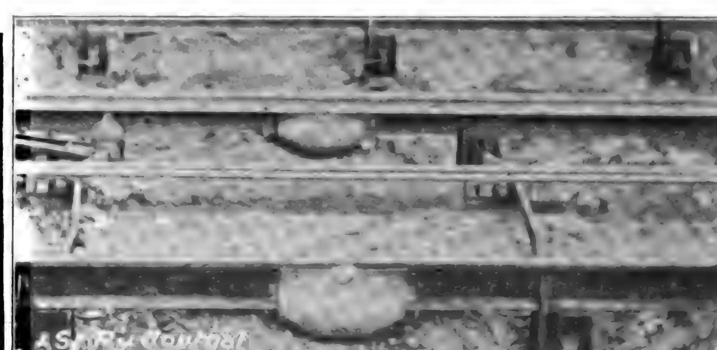


FIG. 3.—THE FINISHED CAST RAIL JOINT.

A LONG ELECTRIC RAILWAY IN FLORIDA.

It is said that an electric railroad from Jacksonville to St. Augustine will be in operation by Jan. 1, 1896. The road will be constructed by the Jacksonville and Tampa Bay Improved Railway Company. This company was chartered by the Legislature to construct and operate a line of railway from Jacksonville to some point on Tampa Bay, with branches running to several important interior towns of the State. The company was promised a grant of 7,000 acres of land per mile for every mile actually built.

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CONTENTS.

SUPPLEMENT.

MUNICIPAL "GAS" AND THE PEOPLE'S LAMPS.

It is perfectly safe to assume that "municipal plants" is one of the subjects of discussion that will not down, but it is deeply to be regretted that some partisans of municipal ownership should be so utterly and so frightfully reckless in the statements they make. When there are so many interesting new things to be paid attention to, it is really a serious pity that scant leisure and valuable space should have to be given up to the correction of grave misstatements that cannot help the cause they are intended to advance and which, nevertheless, prejudice the public mind. There seems to be no help for it, however, and just now we find the papers flooded with wild yarns by "Prof." Frank Parsons, who might well be called the Prince of Liars, if he were not likely to take it as a compliment. This gentleman, to whom we would gladly attribute honest purposes, has, it appears, been expounding his arithmetic of electric lighting in the *Arena*, and an article of his in the August number on "The People's Lamps," is presumably a fair sample of his average effort in this particular branch of fiction.

We may premise our remarks by saying that we have ourselves no prejudice against municipal plants as such. We take pleasure in describing good ones when found, and it will not be forgotten that we made recently a most impartial study and exhaustive digest of the subject with the co-operation, as expert, of Mr. H. A. Foster. The subject is a broad one, and needs all the evidence on it that can possibly be secured, but it has already had too much of the flagrant and violent misrepresentation in which "Prof." Parsons permits himself to indulge.

Mr. Parsons has so many pages of absolute falsities, it is hard to pick out any as worse than the others, but we will take one of his tables as a little sample of his exuberantly imaginative figuring:

TABLE X.

Cost per lamp per year before and after public ownership, the "after" service being the same as or better than the service it replaced.

	Before.	After.
Bangor, Me.	$150	$48
Lewiston, Me.	182	55
Peabody, Mass.	185	62
Bay City, Mich.	110	58
Huntington, Ind.	146	50
Goshen, Ind.	156	77
Bloomington, Ill.	111	51
Chicago, Ill.	250	96
Elgin, Ill.	266	43
Aurora, Ill.	326	70
Fairfield, Ia.	378	70
Marshalltown, Ia.	125	27
Jacksonville, Fla.	24	5

Mr. Parsons may well call these "marvellous facts." We have seen nothing so marvellous since reading "Munchausen's Travels." Time is too short to expose all the lies in this table. We will simply remark that in Chicago the city plant has been supplying light to itself not at $96 per year per light, but at nearly $170. Fairfield, Ia., gets from itself 285 c. p. per hour for one cent. or about half what the great private companies in New York City give. Moreover the Fairfield plant itemizes no repairs although it has been shut down from damage for two weeks at a time! Moreover, again, Fairfield *never* paid a private company $378 a year per light! Aurora, Ill.,

buys coal at $1.80 per ton, and yet it only gets 447 c. p. per hour for one cent; while San Francisco, where the private company has to pay $5.90 per ton, gets 400 c. p. per hour for one cent, or as much as vaunted Huntington, Ind., which charges the salary of its superintendent to the fire department. Bay City instead of getting its light at $58, is in reality mulcting itself at the rate of $140, or more than Buffalo, where the private company gets only $127.50 for 4,000 hours per year.

It is natural that "Prof." Parsons should be paralyzed by astonishment at his own results. Such charlatans usually are. It is part of the show. "Imagine a city," he says "one year paying a private company $200 or $300 for a street lamp and the next year making the light itself at a total cost of from $40 to $70." Yes, indeed, imagine it, for that is all that anybody was ever able to do. It never was seen yet, and we do not think it ever will be seen.

Another piece of enterprise is shown in Table XI, where we are coolly informed that Bangor and Lewiston are on a parity with Boston, the former at $34 and Lewiston at $43 while Boston pays a private company $139. As a matter of fact, when all expenses are figured in, Bangor is spending about $104½ per year per light; while in Lewiston a private company has offered the city service at .02 dollar per hour, while it is spending .0291 dollar itself. But the value of the comparison is seen in the fact that Boston is getting 645 C. P. per hour for 1 cent while Lewiston, with water power, is only getting 687—a good showing for Boston where every expense is far beyond what it could be in Lewiston. The same defence applies to the absurd comparison of Dunkirk, N. Y. with New York City. Here is what Mr. Parsons says:

"Turn to Dunkirk and New York. Both use 480-watt lamps burning all night every night. In both the motive power is steam; coal is $2 a ton in Dunkirk, $3 in New York, a difference of $5 per arc in favor of Dunkirk. But this is more than overcome by the volume and density of business in New York. The Dunkirk plant is confined to the business of lighting 75 street arcs, while the New York plants run 2,625 street arcs, and an enormous commercial system that gives them a heavy load all day as well as all night. If New York owned her electric system, and managed it with honest efficiency, she would get her light for less than the Dunkirk cost."

Merely prefacing our comment with the fervent prayer that New York may have no additions to its municipal enterprises, we would point out that even on its own showing, with many items of expense left out, little Dunkirk only gets 718 C. P. per hour for one cent, while New York, which everyone knows to be the costliest city in the country to do business in, gets its electric light from private companies at the rate of 555 C. P. per hour for 1 cent; which is a good deal better than Herkimer, N. Y. pretends to do, and more than twice as good as the performance of Jamestown, N. Y.

To be brief, these municipal figures of "Prof." Parsons and others of his type are "gas," and prove nothing except the unreliability of their authors. But they might well be expected from a man who puts forth the following as his creed:

"It is all a very simple matter. If the people acquire a business that M owns, the people will get the profits that M now gets."

That leaves nothing to be said.

COMMUTATOR AND BRUSH FRICTION.

We are pleased to present elsewhere in this issue what we believe to be the first definite information concerning brush friction and resistance. It is strange, indeed, that in spite of the very advanced state of dynamo and motor design, such an important factor is practically ignored or at best is not considered quantitatively. Eddy currents and hysteresis do not consume much larger percentages of the total energy, nevertheless they are determined with the greatest care and accuracy.

The experiments and resulting data given by Messrs. Cox and Buck in their thesis will now enable engineers to treat brush friction and resistance as a quantitative part of the design of dynamos, and the surface and pressure of brushes corresponding to a given amount of power lost by friction and resistance may be definitely specified.

Results are given for a smooth cast iron pulley as well as for the ordinary copper commutator. These show that the heterogeneous surface of the latter gives greater friction and resistance, as might be expected. This is interesting as a comparison, but we suspect that the experiments with iron surfaces were due to Professor Crocker's influence, and that he intends to apply the results to unipolar dynamos which he advocated in his Institute paper a year ago. From this point of view the results are encouraging, since the friction and resistance are low as we have seen, and *contrary to the very generally accepted idea the contact resistance is only slightly increased by oiling the surface,* whereas the friction is enormously reduced. The data given must certainly be of great assistance in designing a unipolar dynamo.

CONSTANT SPEED RAILWAY MOTORS.

RAILWAY motor regulation has occupied much of the attention of electrical engineers and still claims it, and rightly so, for there are few details in connection with railway work that have a greater influence on the coal economy at the central station than the operation of the motors themselves. However the station superintendent may strive at perfection in his department, his efforts will be largely nullified by heavy fluctuating drafts of current carrying with them irregular and wasteful action of the engines. The series parallel controller, has, it is true, done much to mitigate this evil, but even at the present time the starting current taken by electric railway motors and when running at slow speed is greater than ideal conditions would call for. To reach these ideals, it has been proposed to operate by means of a continuously revolving constant speed shunt motor with variable gearing, and a number of plans have been brought forward with this end in view. The hydraulic gear seems to have a strong fascination for inventors in this department and it certainly presents advantages not to be met with in rigid mechanical gears. We present on another page the latest work in this field due to Mr. Harry E. Dey, which will well repay study. With the alternating current gradually tending towards practical railway work such a system of gearing permitting the employment of a single-phase synchronous motor, might find an immediate application.

TELEPHONY.

THE CALLENDER AUTOMATIC TELEPHONE EXCHANGE SYSTEM.

OUR readers will recall the detailed and illustrated description of this system which appeared in our issue of January 9th. Since then the apparatus has been much improved and the demonstration lately given of the perfected system has attracted considerable attention.

The system, it will be recalled, is founded upon a percentage basis, the "calls" being the units of work. A subscriber on turning in a call to the exchange has there assigned to him a signal registering mechanism. The numerical value of his signal or call for connection with some other telephone is then indicated and immediately afterwards it is registered in the numeralizing division of the apparatus. The signal registering mechanism then passes out of his control for use by other subscribers. These mechanisms, as well as all others in the system, are present in exact proportion to their use as determined by the statistics showing the maximum number of calls likely to be received at the busiest part of the day.

The calling subscriber having registered the number of the telephone with which he desires connection has then assigned to him one of the connecting and signaling mechanisms not then in use. He is then connected to the telephone called, if that telephone is not in use at the time, and a "connected" signal of one long ring is sent from the exchange over the lines of both telephones. The lines are then left connected through a percentage connecting mechanism, all other apparatus previously in use for obtaining the connection and for signaling the telephones when connected having reverted automatically to the normal condition, free for the common use of other subscribers. The connecting mechanisms constitute the largest percentage group found in the system—ten per cent. of the total number of subscribers—allowing twenty per cent., or one fifth, of the telephones to be interconnected at one time. The other mechanisms form groups of lesser percentage proportions, the signal registering group, for instance, being only one per cent. of the whole number of telephones connected to the exchange.

The improvements recently effected are as follows:—The numeralizing apparatus with its system of fractional circuits has been eliminated entirely and its functions are now performed by other circuits in use at other times for other work. The separating apparatus for automatically separating the various series of impulses constituting the "call" has been improved and simplified, its cost being reduced to a minimum and its action made positive in every way.

The system as now constructed can be installed at only a fraction of the cost of installing the ordinary hand-operated switchboard. It is claimed for this percentage system that, unlike any other, it becomes cheaper per capita as the size of the exchange is increased, thus making it an important factor in obtaining much lower rates than are possible with any other system. Our engraving shows the Callender exchange apparatus required for 100 subscribers, as exhibited in operation in the Decker Building, Union Square, this city.

THE CALLENDER 100-SUBSCRIBER AUTOMATIC TELEPHONE EXCHANGE.

THE STANDARD TELEPHONE AND ELECTRIC COMPANY.

THE recently published circular of the Standard Telephone and Electric Co., of Madison, Wis., describes the characteristic features of the Standard loud speaking telephone, which embodies the Mildé long-distance transmitter. This type of instrument has been adopted by the French House of Parliament, the Admiralty and War Offices, Post-office telephone exchange, railway companies, etc., by the British, Italian, Spanish and South American Governments; some of the telephone companies of Italy and Egypt, and in the United States by railway companies and other corporations. It is claimed that the "Mildé" transmitter does not pack or get out of order, does not require adjustment, and is "as sensitive as a Blake, and as powerful as a solid-back."

These telephones have been operated successfully over upwards of 500 miles of ordinary telegraph wire, with numerous relays in circuit, run on poles in parallel with other wires over which telegraph messages were being transmitted and where the induction was very great. Under all these conditions the "Standard"

telephone has proved itself equal to the best instruments made for long distance work, and admirably adapted for ordinary use.

The company is now actively pushing its business, especially in the automatic exchange system outfits. These are complete with switches, and adapted for use in towns, villages, interior plants, and all purposes where a limited number of telephones are installed in a circumscribed area. Another instrument which has been well received is their Standard No. 2, or "Warehouse" telephone, for connection between different departments. No exchange is necessary. Each instrument having its switchboard, instant communication is secured by turning the switch to the desired number. The lines can be used by more than two persons at one time. For instance, with a system of nine instruments, Nos. 1 and 3, 2 and 8, 5 and 7, 4 and 9 can converse simultaneously without interfering with one another.

A TELEPHONE ROMANCE IN MAINE.

Here is a little romance that occurred recently in Portland. He was a clerk in a large wholesale house and used the telephone constantly. At certain periods his calls were answered by a sweet voice, which seemed to sooth his tired, worn-out nerves and strengthen him wonderfully. He grew to listen for that voice, dreamed of it, and finally it became a part of his life. One evening in the theatre he heard it behind him and recognized it at once. For a long time he sat as one dazed and dared not look at the possessor of the voice for fear he would be disappointed. But he wasn't, and now they're engaged.

BELL TELEPHONE.

The Bell Company is doing, says the *Boston Journal*, what all corporations of the kind working under broad patents, must do to insure their stability. It is coming to rely on its strength as a manufacturing corporation and its ability to meet any future competitor by offering the best service at the lowest rate. The reduction of its charges to subordinate companies enables these to extend their business and swell their receipts, gains which will ultimately appear in the net results of those subordinate companies. It is an appreciation of this that has led to the buying for investment of the stocks of those companies. The Bell figures for the month ending July 20 are :

	1895.	1894.	Inc.
Gross output	13,837	6,430	7,407
Returned	7,518	5,754	1,759
Net output	6,324	676	5,648
Since Dec. 20 :	1894–95.	1893–94.	Inc.
Gross output	98,896	47,455	51,441
Returned	47.121	40,449	6,672
Net output	51,775	7,0 6	44,769
Total outstanding	634,283	573,497	60,786

TELEPHONE NOTES.

GREAT FALLS, MONT.—The Great Falls and Lewistown telephone line is now complete.

CLARKSVILLE, TENN.—A project is on foot to have Dover, Erin and other points connected with this city by telephone, and a subscription list to this end is now being circulated.

FORT DODGE, IA.—The city council has granted a franchise to the Phoenix Telephone Company, of Indianapolis, to operate in this city.

MIDDLETOWN, N. Y.—At a meeting of the Board of Directors of the Orange County Telephone Company Mr. A. R. Pflaum was selected as general manager of the company.

SAVANNAH, GA.—The erection of the building for the Southern Bell Telephone Company will begin Oct. 1, and it will be ready for occupancy by January 1. It will cost $25,000.

BRAZIL, IND.—A company of Lebanon capitalists, headed by Frank C. Reagan, have secured a franchise from the city of Brazil and will put in a telephone system at that place.

HOUSTON, TEX.—Mr. Ben Kiam, one of the directors of the Texas Telegraph and Telephone company, left recently for the East. The purpose of his visit was to contract for instruments to be used by the new company.

MIDDLETOWN, N. Y.—The Sullivan County Telephone Co. has about seventy-five telephones in operation on its lines. The system is now being extended to Callicoon Depot by way of North Branch and Hortonville.

DECATUR, ILL.—The stockholders of the Decatur Mutual Telephone Company are trying to get possession of the plant, which was sold under chattel mortgage to John A. Brown for $9,000. It is worth $25,000 and the receipts have been $17,000, with expenditures $16,000 and $700 not accounted for.

SYRACUSE, N. Y.—Plans for the new telephone building have been submitted by Henry Wilkinson and approved.

MT. VERNON SPRINGS, N. C.—J. M. Foust will establish an exchange.

FRANKFORT, IND.—A rate war is on between the Frankfort Telephone Company and the Central Union Telephone Company.

STOCKBRIDGE, MASS.—The promoters of a telephone exchange for Stockbridge have thus far secured thirty subscribers, and the work of putting up the wires will begin immediately.

VINEYARD HAVEN, MASS.—Dr. C. F. Lane has made a contract with P. H. Carr of Waterbury, Conn., to complete his Island telephone system and put it in first-class condition, with all the newest improvements.

WAUSAU, WIS.—The Wausau Telephone company, which was recently organized with a capital of $10,000, has engaged as manager F. P. Crocker, for years the manager of the Wisconsin Telephone company in Wausau.

SIMSBURY, CONN.—The Southern New England Telephone Co. is preparing to connect the towns of Granby, Canton, East Granby, Avon and the village of Tarriffville with Simsbury, the above places forming the Simsbury exchange.

TRENTON, N. J.—If the present plans of the New Jersey Standard Telephone Company are carried out, Trentonians are to enjoy the benefits of a telephone service at less than one-half the present rates.

ALICE, TEX.—The Alice, Wade City & Corpus Christi Telephone Co. has been organized with a capital stock of $10,000; John Wade, president; George Newberry, vice-president, and L. G. Collins, secretary and treasurer.

MEMPHIS, TENN.—The Memphis Telephone Company has filed its charter in the register's office. The names of the charter members are : J. T. Jefferson, J. C. Neeley, Fred Orgill, E. G. Robinson and J. C. Neeley, Jr.

ANDERSON, IND.—F. W. Bradbury has sold out his interest in the local American Telephone Construction Company, of this city, to his partner, C. M. Harriman, who thus becomes owner of the New Castle plant and the franchises at Memphis, Tenn., and Winchester, this State.

UNIONTOWN, PA.—The Home Telephone company of this place, which secured a charter a year ago, have decided to go ahead with the construction of an exchange. The local Bell Telephone exchange has more than doubled its list of subscribers since it reduced the yearly rental 50 per cent.

WHEELING, W. VA.—Mr. M. R. Wolff, general manager of the Central District Telephone Company, of Wheeling, has completed arrangements for the erection of a line from Morgantown to Uniontown, Pa., which will be the means of connecting the interior of West Virginia with Pittsburg.

CLEVELAND, O.—The movement to secure better service and cheaper rates from the telephone company or else to get a new company in the city has been most favorably received and a large number of subscribers have indorsed the agitation. The leader in the movement is Mr. W. H. Gobielle.

PENDLETON, WASH.—This city will soon be connected with Long Creek by telephone. Crews of men are now at work stringing and laying poles, and telephones are in operation for a distance of about 20 miles. When Long Creek, 100 miles distant, has been reached, the extension to Burns will be made, and Grant county will have its first telephone line.

HAMILTON, O.—Articles have been filed with the secretary of state for the incorporation of the Hamilton, Hughes and Monroe Telephone Co. The capital stock is $5,000, divided into 500 shares of $10 each and the incorporators are F. M. Hughes, C. E. Griesmer, A. E. Schenck, J. E. Hughes, D. S. Rose, J. P. LeSourd and L. C. Shafor.

INDIANAPOLIS, IND.—The Phoenix Telephone Company had a hearing before the Board of Works, and made a proposition that the company would pay 5 per cent. of its gross income four years from the date of beginning business, and would continue to pay that rate of special tax the rest of the term of the contract.

ELIZABETH, N. J.—The New York and New Jersey Telephone Company has secured a temporary injunction against the Elizabeth Mutual Telephone Company, which it was shown had not organized under the State law, and had failed to deposit with the State Treasurer $10,000, being one-third of its capital. The company will be compelled to reorganize entirely.

LONG DISTANCE TRANSMISSION AT 10,000 VOLTS.

(The Pomona Plant.)—III.

BY GEORGE HERBERT WINSLOW.

Some curious conditions met with in the operation of the plant are shown in the ampere curves in Fig. 4, which were taken during very wet weather. Taking the maximum load measurements at 7 P. M. for March 14th and 8th, we note that the total apparent energy delivered by the sub-stations is 78 per cent. and 75 per cent., respectively, of that delivered by the generator, while for a smaller load at 9 P. M. the respective percentages decrease to 47.6 per cent. and 48.6 per cent. in spite of the fact that the apparent energy delivered by the generator is in the latter case only half as great as in the former. The results are due to changes in the angle of lag caused by changing the load.

In the cañon curve of March 8th, the load at 9.30 P. M. is seen to have increased considerably, although the sub-station loads were decreasing. This increase was due to the fact that the rain which had previously ceased to fall at Pomona, began again.

The electrical resistance of the Pomona circuit is 74.9 ohms and that of San Bernardino 156.4 ohms at about 90 degrees F.

The insulation resistance of the circuits varies from far beyond the limits of an 11-megohm bridge in dry, hot summer weather to as low as 0.65 megohm during light rain. The latter value is that obtained with the two San Bernardino wires in series, and represents an insulation-resistance per mile of over 37 megohms. On a clear, sunny day the insulation-resistances of one Pomona wire and of one San Bernardino wire were respectively 11 megohms and 5½ megohms, which are in the exact relation which would be expected.

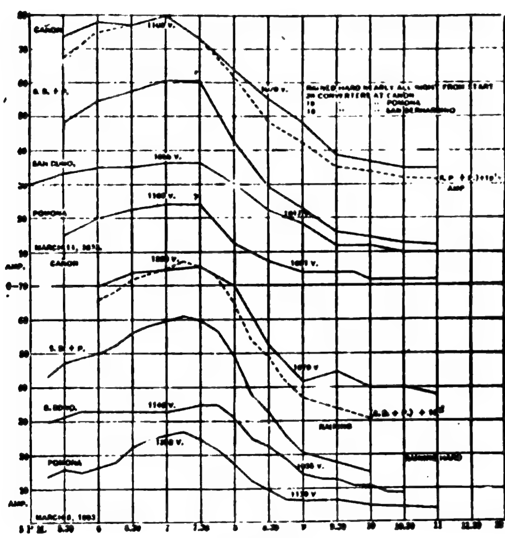


Fig. 4.

The lines cannot be tested for grounds or for continuity with a magneto bell, as their capacity is such that the bell will ring loudly when the wire is perfectly insulated and the circuit open. This capacity also prevents the use of the ordinary converter test for line leakage, as the lamp on the secondary will burn as though there were a ground even when the line is perfectly clear. By adding lamps, however, the light may be cut down until the last lamp added extinguishes them all. This would not occur if the light of the first lamp was due to a difference of potential on the primary caused by a ground, as then the added lamps would become as bright as the first. The primary current is thus seen to be limited, and to be due to the capacity of the line. If the proper number of lamps has been added to just secure darkness when the line is known to be free from grounds the converter may be used to show grounds on that line, since the presence of a ground will cause all the lamps to brighten. The line test should only be made after ascertaining with one lamp that the generator is not grounded, as otherwise the leakage current for the greater number of lamps might burn the insulation of the generator.

A very good example of Prof. Fleming's "condenser effect" was met with in the Summer of 1893, while the engineer was trying this converter test for measuring line leakage. The primary of a 1000—100 volt converter was connected between the ground and one terminal of the generator, the other terminal of the latter being connected to one wire of the Pomona circuit. The resulting secondary pressure was 30 volts, which made one lamp burn dimly. When ten lamps were turned on, the pressure dropped to 14 volts. When all lamps were turned off the pressure became ten times as great, or 140 volts. One generator brush was then raised, and the second leg of the circuit was connected to the first. On completing the circuit again there was a sudden flash of the armature, followed by a crackling noise and a brush discharge which lasted until the circuit was broken. The Pomona wires were then disconnected from the dynamo terminal, which was left free. With this arrangement faint sparks and a glow were noticed, as though the armature winding were grounded on the core, but a Wheatstone bridge test showed an insulation resistance of over 10 megohms. Since then the machine has been used regularly and has not broken down, so it is evident the spark must have resulted from a sudden increase of the potential of the armature winding above that of its core, which latter was permanently connected to earth.

This sudden increase may be explained as follows. On closing the circuit the condenser formed by the line and the earth began to discharge through the metallic circuit afforded by the armature and converter windings, but the inductance of this circuit checked the discharge so quickly as to produce an excessive pressure which could only be relieved by the discharge taking place through the insulation of the armature-winding to the grounded core, which is what happened.

A comparison of the San Bernardino switchboard voltmeter was made with a Weston instrument and gave important results.

1st. With *no load* the San Bernardino instrument was about 14 volts (11.2 per cent.) low at 125 volts, while at 97 volts it was only 11.7 volts (12 per cent.) low.

2nd. With a *city load* (inductive, consisting of lightly loaded converters) of 7½ amperes it was 11 volts low between 107 and 96 volts, while for 15 amperes it was only 8 5 volts low. Further increase in load caused further reduction in the difference, until for 40 amperes the instrument was only 5 volts low.

3rd. With a *tank load* (non-inductive) of 9 amperes it was only 9 volts low at 99 volts, and as the load was increased the difference decreased until for 97 amperes the instrument read the same as the Weston.

It is evident from these observations that a voltmeter which consists essentially of a solenoid and a movable core, is not the proper type of instrument for circuits such as those used in the present case, in which transmission circuits of great length are used in conjunction with transformers. The voltage at San Bernardino during the tests was therefore measured with a Weston portable voltmeter.

THE NEW CONSOLIDATED POWER HOUSE FOR TOLEDO, O.

It has already been announced in these pages that all the electrical plants and companies in Toledo have been consolidated, and that a new power house is to be built for the whole service. The work has been entrusted to Mr. F. Sargent, M. E., of Sargent & Lundy, whose central station designing is to be seen in several of the largest plants in the country.

The new station will have many new features, and so far as steam economy goes, that is, the indicated horse power in the cylinder of the engine as compared with the coal burned, will, it is expected, be lower than any station yet built. In fact, if the engine builders carry out their contract successfully the chances for ever building a station to beat Toledo on steam economy will be very slim. The only way to beat it will be by increasing the steam pressure. The electrical features of the station are not altogether in the line of the highest economy, although the margin is small. Mr. Sargent, as consulting engineer, is combining the old Western Electric station, which was purely an arc lighting station, the Toledo Electric Company, which ran arc lights, incandescent lights and stationary power service, and the Toledo Consolidated Street Railway Company, which operates eighty miles of railway. The new station will be located at the corner of Water and Madison Streets on the river front. The engine room will be 70 feet wide by 200 feet long, and the boiler room 40 feet wide by 200 feet long. The plans for the station are being prepared by Messrs. D. H. Burnham & Company, the Chicago architects. All the old engines and electrical railway station apparatus will be abandoned. The arc light machines from both stations, the alternating current incandescent machinery, and the stationary power machinery will, however, be used in the new station, to be driven from a line of shafting. Contracts for the new machinery have been awarded as follows: Four engines to carry an economical load of 700 H. P. each, and a maximum load of 1200 H. P. of the cross compound type, have been awarded to the American Wheelock Engine Company, the engines to be built at Wm. Cramp & Sons Ship & Engine Building Company's works, Philadelphia. These engines are guaranteed to produce an indicated horse power on 13 lbs. of steam per hour, including such steam as may be used for jackets and reheating coils. Three of these engines will have General Electric Company, 500 kilowatt direct coupled railway generators on the shaft for operating the railway service. The fly wheel of each engine is also provided with grooves for rope drive to the line of shafting operating the lighting machinery, the arrangement being such that the engines can be used jointly or

separately for either the lighting machinery or the railway work. This arrangement admits of a comparatively small investment in engines, considering the large amount of work and variety of work to be done.

The fourth engine has no railway generator on it, but otherwise it is exactly like the other engines, the intention being to equip it with a railway generator at a later date. The boilers have been awarded to the Heine Boiler Company of St. Louis, and the Green Economizer Co. have secured the contract for economizers.

The heart of the city is to be equipped with an underground system, and it has been decided to use the Edison three wire system for this purpose, so that the plant when finished will be arranged as follows:—Municipal arc lighting by series arc light system; arc and incandescent lighting and stationary power service for the centre of the town by Edison three wire system; incandescent lighting for the outskirts and suburbs by the alternating current system using the old machinery for the present; railway service by direct coupled General Electric generators; and a special service of 500 volt direct current for operating elevators and heavy power work, such as would be liable to interfere with the lighting service, if operated from the three wire system, for the centre of the town. All of the apparatus outside of the railway generators will be driven from the line shaft, for the present, but it is expected to put in direct coupled generators for the Edison three wire system as soon as the load will warrant using units of 500 H. P. capacity.

THE MINERAL INDUSTRY, ESPECIALLY ALUMINUM AND COPPER.

The *Engineering and Mining Journal* has issued in a carefully prepared statistical supplement some valuable facts from "The Mineral World," Volume III of which is now issuing, in regard to the mineral and metal production of the United States in 1893 and 1894.

The total value of the mineral products of the country, as given in a table prepared by Mr. Richard P. Rothwell, editor of the *Engineering and Mining Journal*, was $615,887,108 in 1893, and $553,352,996 in 1894, showing a decrease in values (not quantities) last year of $62,534,112, or 10 per cent.

To arrive at the net value of the mineral and metal production in each year, a deduction is made from the total for that of substances, the value of which has necessarily been duplicated in the tables. Such, for instance, are the antimony ore used in making the metal; the bauxite used in making alum and aluminum; the coal—chiefly slack—used in making coke; the copper used in making sulphate; most of the lead used in making white lead; the manganese ore used in making spiegeleisen and ferromanganese, which are included in pig iron, zinc used in making zinc oxide, etc., etc. A careful estimate of the proper amount of these deductions gives $13,000,000 in 1894, and $15,000,000 in 1893, which would leave the net total value of our mineral production in 1893 equivalent to $600,887,108; and in 1894 equivalent to $540,352,996.

To make a fair comparison between the two years, the quantities of the several articles produced should be examined. It is impossible, of course, to give any total in quantities when so many materials and different units of measure are taken into consideration. The only total that can be given is that of values and the decrease in this amount is in most cases very much greater than the falling off in actual quantities produced. The year 1894 will long be remembered as one of low prices and in almost every industry values were brought down to a point lower than had ever been before known. It was a repetition of the experience of former panic periods, only intensified in our own case by the general distrust provoked by the condition of the currency. It seems to be an unavoidable result of the concentration of capital and the continual improvement in processes which characterize the present age, that production should increase in a greater ratio than consumption, and that at greater or less intervals there should be a period when a halt must be called until the demand can again increase to the level of the supply; and 1894 being one of those periods the producers suffered accordingly.

Specially interesting from an electrical point of view in the comprehensive table are the data on aluminum and copper. These are given as:

Products.	Customary Measures.	1893. Quantity. Customary Measures.	1893. Quantity. Metric Tons.	1893. Value at Place of Production.	1894. Quantity. Customary Measures.	1894. Quantity. Metric Tons.	1894. Value at Place of Production.
METALS.							
Aluminum.	Pounds	a312,000	142	202,800	817,600	371	490,560
Copper	Pounds.	327,255,788	148,441	35,504,314	353,179,997	110,483	33,540,489

To illustrate what has been said with regard to the comparison of values, it will perhaps be well to take a few instances from the table. Thus, while our total production of copper showed an increase of 26,250,000 lbs. the estimated value at the place of production was lower by $1,640,000 in 1894 than in 1893. Again, the production of zinc decreased only 2,250 tons or about 3 per cent., while the value reported was less by about $1,000,000 or 16 6 per cent. The decrease in the production of pig iron was 386,000 tons or 5.5 per cent. while the decrease in value was $21,-900,000 or nearly 24 per cent.; many similar instances might be taken from the table to show that the total reduction in value of the mineral production of $62,534,112, or 10 per cent. represented very much less than that proportion—probably not over 5 or 6 per cent.—in actual quantities produced.

To sum up the matter briefly, the table given shows a moderate decrease in production, a much larger proportional decrease in the value or prices, but in both cases a decrease upon the whole less than the general expectation of its amount. It shows also that in a year of extremely unfavorable conditions the mineral production of the United States by its extent and variety still gives the country the foremost place among the nations of the world—a place which is, above all, surprising, when we consider the comparatively brief period in which the industry has been built up.

The conditions under which the year closes were far more favorable than those with which it opened. The year 1895 is already beginning to show a very great improvement over its predecessor, and there is warrant for believing that 1896 in its turn will show a development exceeding any which has yet been seen in the history of the mineral industry.

THE THERAPEUTIC ACTION OF CURRENTS OF HIGH FREQUENCY.

It is known, *L'Eclairage Electrique* remarks, that M. d'Arsonval has introduced into electrotherapy new processes of electrization based on the employment of currents of high frequency. MM. Apostoli and Berlioz have been experimenting for over a year with one of his methods, self-conduction, upon 65 invalids, and they have come to the following conclusions: Currents of high frequency, when they completely envelop the patient and act by self conduction, are inefficacious and impotent against the majority of hysterical troubles and against certain neuralgic complaints, but the same currents exercise a powerful influence on the nutritive energy.

ANOTHER TELEGRAPH LINE TO ALASKA.

A special dispatch from Seattle, Wash., of July 26, says:—"John W. Mackay will leave on the steamer *Queen* to-morrow morning for Alaska. He is accompanied by C. R. Hosmer, general manager of the Canadian Pacific telegraph, and it is believed his visit north has something to do with the early construction of a telegraph line to Alaska from Vancouver, B. C."

ELECTRIC POWER TRANSMISSION IN VIRGINIA.

A special dispatch from Danville, Va., says: "One of the most gigantic enterprises ever undertaken in Danville is the organization of the Dan River Power and Electric Company, which was effected by the election of the following officers: President, Thomas B. Fitzgerald; vice-president, William P. Bethel; secretary and treasurer, R. A. James. Directors, Frank X. Burton, John H. Schoolfield, James E. Schoolfield and R. Addison Schoolfield. The charter provides for a minimum capital stock of $75,000, with a maximum of $750,000.

TESTING THE ELECTRIC LAUNCHES FOR THE ATLANTA EXPOSITION.

A trial trip was made on July 31, of the first of the six launches contracted for by the Electric Transportation Co., with the Atlanta Exposition authorities. These launches are a portion of the famous World's Fair fleet, of which Gen. C. H. Barney, the president of the new company, was commodore. It is almost needless to say that the trip was made smoothly and successfully, with a party of about a dozen, at a speed varying from 6 to 10 miles an hour on the waters of the upper Harlem River. The boats are to be shipped to Atlanta early this month, all ready for work. The lake at the Exposition is about 1 mile in circumference, and the boats will carry passengers twice around for 25 cents. There are five landings, and the charging station is in Machinery Hall, near the boat house. The boats will themselves constitute a very interesting exhibit, and the Electric Storage Battery Co. will have a fine display of batteries, for all classes of work, in the boat house. The Electric Transportation Co. pays 18 per cent. of its gross receipts for the franchise. Its New York offices are at 27-29 Pine street.

Letters to the Editor.

THE NIAGARA PLANS FOR CANADA.

I have just seen the account of the Niagara work in your journal. There seems to be something wrong about the account of the Canadian proposals. I do not know what plan has been finally decided on. But the plan I submitted was very like if not identical with that on page 571, of your issue of June 26, which you call the plan adopted. It certainly was not the plan with underground chamber which you seem to attribute to me.

W. C. Unwin.

London, July 18, 1895.

[Our attribution of the plan referred to to Prof. Unwin was due to a misunderstanding, and we are, therefore, glad to give space to Prof. Unwin's letter. The plans are correct, however, as printed.—Eds. E. E.]

THE ECONOMY OF CONSTANT POTENTIAL ARC LIGHTING.

Members of the electrical profession are not usually to be accused of running too much in a groove, or of not being open to the reception of new ideas. But the statement that constant current arc lighting is much cheaper than constant potential arc lighting is so often made that it has come to be received as electrical gospel. This statement is again repeated in the Engineer of July 17 by Mr. E. R. Knowles. It seems to be assumed that the loss in resistance on a constant potential circuit is the only factor in the calculation, without considering others which may enter into the sum total of cost. Will Mr. Knowles oblige a seeker after light by considering the following propositions affecting arc lighting, and then put a little of his well-known mathematical skill into working out a correct solution?

Admitting that his proposition is correct, viz., that two 7 ampere arc lamps require 330 watts on a constant current circuit and 385 watts on a constant potential circuit, let him consider the following questions: Has or has it not been determined that a large multipolar generator of the constant potential type is a much more efficient generator than the customary (or any) type of constant current machine? Silvanus P. Thompson in his well known book on "Dynamo Electric Machinery" gives the efficiency of a standard type of constant current machine at 86 per cent. when new. What is it when old? The better class of constant potential machines give an efficiency of 95 per cent. or higher, and retain it. How much does the superior efficiency of the generator help the constant potential lamp?

In a plant of 1,000 arc lights, it would be necessary to run 10 constant current machines of 100 lights each, if the best modern machines are used. With a constant potential system, one machine would easily do the work. Query, what would be the difference in cost of driving the ten machines over the one, either by belting and countershafting from one large engine, or by ten engines direct connected to dynamos? Calculate difference in friction, oil, labor, interest on cost of real estate and building, wear and tear of belting (if any used), and increased depreciation on high speed machines in place of slow speed.

Constant current armatures have been known to burn out. What is a fair allowance per annum for this item, over wear of a good constant potential armature?

If 100-light machines are used on the constant current system, a potential of 5,000 volts or over must be used. What is the danger factor on this class of wiring, and what is the extra risk worth per annum to the company using it?

How much will it cost yearly to maintain good insulation on lines carrying 5,000 volts over the cost of the same work on circuits carrying 220?

Out here in the wild and woolly West some of our college professors are teaching us that as much light can be had from a cored carbon at 8 amperes as is usually obtained from the common carbons with 9½, and at about the same cost per hour for carbons. We are building stations, using constant potential arc lighting for streets and stores, and operate our incandescent circuits from the same direct connected dynamo. We think that results show lower operating expenses and better lighting from these systems than from the old style stations containing several types of dynamos. If we are so very wrong in our conclusions, and Mr. Knowles will show us just where we are wrong, we will repent in sackcloth and ashes and go back to the good old way. We will admit that we use more wire by doing things in this manner, but by running four lamps in series on 220 volts with iron line wire in place of the usual resistance coil, it is surprising how little wire can be made to go a long way, with properly proportioned feeders.

We think that good carbons mean less cost for current, that one big slow speed generator is better than a number of small ones, and that the resistance loss is more than saved in the absence of belting and shafting, in the superior economy and efficiency of the generator, in saving of employees and absence of danger, while the first cost, after paying for more copper, is no more, because we save in machinery, building, real estate, and many other items. If we are so woefully wrong, won't some one please show us just how much we are wrong?

W. N. Stewart.

Minneapolis, Minn., July 24, 1894.

THE FORBES-ROWLAND NIAGARA CONTROVERSY.

In a card supplementing the letter of Prof. Forbes, which appeared in our last issue, that gentleman says in a note to London *Lightning*:—

"It has been pointed out to me that in answering Prof. Rowland's letter on 'Niagara' last week I may have left some people with the impression that he had made recommendations about dynamos which had been adopted. Let me point out that when he says there is to be iron in the armature, and over 25 tons weight, he is saying nothing more than that the Siemens or Ferranti type is not to be used, as all of the designs sent in, about twenty in number, agreed on these features. He never thought of making the external fields revolve, and he wanted the armature to be the revolving part. My design opposed his views on both points. In fact, he had nothing whatever to say that could be of assistance to us, and when he gave in about alternating currents, the directors of the company wanted nothing more."

THE SELF WINDING STOCK TICKER.

BY A. A. KNUDSON.

Having read the article referring to recent improvements in the Stock Quotation Instrument or "Ticker" (so called) in The Electrical Engineer of July 31st, I am reminded of my own early attempts in this direction, a brief statement of which may be of possible interest to some of your readers, as the instrument I produced years ago contained the very principle which is now being so very universally adopted. The improvement referred to, is simply doing away with the weight, used to give power to the train of wheels, and also doing away with most of the wheel train itself, substituting in place of all this a small spring wound by the action of the press magnets, and controlled by a ratchet wheel and pawls. As the instrument is operated, this small spring is continually being wound and can never entirely run down, other magnets in the instrument being employed to actuate or release the escapement.

During the year 1873 while employed as an inspector in the company furnishing printing telegraph instruments for stock quotations in New York—then known as the Gold and Stock Telegraph Co.—a patent was granted me containing this self-winding principle, numbered 140,148 and dated June 24th of that year. This patent however represented an instrument with a separate pair of magnets in the same circuit with the press magnets to do the winding, or as then constructed strained out a spiral spring, the relaxation of which gave power to the escapement wheel. A machine was made however to do the winding, as now, direct from the press mechanism.

The brief history and ultimate fate of this patent may be of some interest. The officers of the Company to whom the instrument was first shown at that time failed to see any particular merit in it, and declined to make an offer for the patent. Later on this instrument was brought to the notice of Hon. Levi P. Morton, the present Governor of New York State, who at that time was interested in the old Atlantic & Pacific Telegraph Co. and with the foresight which has always characterized that gentleman, he saw sufficient merit in the performance of the instrument to purchase the patent on behalf of that company, the intention being to establish a competing system with the company then in the field. Through various causes, however, the scheme fell through, and the patent was finally bought by the Western Union Telegraph Co. in 1876, consigned to a pigeon-hole, where with many others it slept out its natural life of 17 years, expiring in 1890.

Although 23 years have passed since this invention was first made, it is to me no little satisfaction to see it even at this late day coming into such general use; and while much credit is due to those who have applied this principle to the present instruments, I think the records will show that I am entitled to what little credit there may be, of being the first to devise and patent a self winding printing telegraph instrument.

As now made and operated it would be difficult to find a more simple and efficient instrument of its class in the wide field of electro-mechanics. The statement in your article referred to that "some 900 of the 'tickers' in New York City have already been changed from weight machines to self-winders and a large number of new ones are in process of construction," demonstrates the success of the resurrected idea so long buried in oblivion.

Mr. Augustus Noll writes: "I am very much interested in the Data Sheets as arranged by Mr. Albert B. Herrick, which are published as a supplement to The Electrical Engineer."

LITERATURE.

Street Railway Investments: A Study in Values. By Edward E. Higgins. New York. Street Railway Publishing Co., 1895. Price, $2.

THE professed object of the author of this work is to furnish intending investors in and owners of street-railway securities with a trustworthy compilation of statistical information respecting this class of property, and as complete an analysis as may be of the signification of the figures thus far obtainable. While the author is compelled to admit that many of his generalizations and predictions of the probable limits of gross and net earnings of these properties, under different conditions, have unavoidably been based upon data in many respects insufficient, and hence that it is "far from being a satisfactory treatment of a difficult subject," yet it must on the other hand be said unreservedly that it was a work which needed to be written, and also that, under existing conditions, it would hardly have been possible for any one to have achieved a greater measure of success than that with which the author must be credited by a candid and competent critic.

There is a great difference in different States of the Union as to the trustworthiness of the published statistics obtainable. The uniform system of accounting and reports required in Massachusetts secures results, the substantial truthfulness of which is hardly open to question, and the same is measurably true of New York. As to the returns published in some other States, of which New Jersey and Pennsylvania may be mentioned as conspicuous examples, the less said, the better. They are chaotic, misleading, and not infrequently fraudulent. Extensive use has evidently been made by the author of the information gathered by H. C. Adams for the federal census of 1890, which, as he observes "was admirably planned and patiently followed up by detailed correspondence."

The figures thus gathered have been compiled and arranged in great detail upon a large tabular sheet, which folds into a pocket at the back of the book, thus rendering it extremely convenient for reference. This exhibit gives information respecting 189 different centres of population, and the local street railway systems by which they are served, varying in population from 15,000 to a million and a half, and also, in a class by themselves, 12 interurban systems. The presentation is so arranged as to provide for giving full details of the physical characteristics of each case, the population served, the capitalization, indebtedness, gross and net earnings per mile and per capita, etc., while the text is in fact nothing more than a running commentary on the facts exhibited in the tabular schedule. Probably no one would be more ready than the author to admit the various imperfections which must necessarily arise, not merely from the insufficiency in too many cases of the returns as above adverted to, but also from the fact that the majority of the electric systems discussed have been in complete running condition for so short a period that the actual cost of operation, and especially the depreciation figure, is yet largely a matter of guesswork, even in the largest and oldest systems. Nevertheless, in justice to the author, it must be said that in no case has he undertaken to be more positive in his deductions and predictions than the accessible facts appear to justify, and for this reason, his cautiously expressed opinions are justly entitled to much weight.

The plan of treatment which has been adopted, and which appears to be an eminently judicious one, is to group the properties in a number of classes, the divisions between which are determined by the population served, these divisions being fixed, for convenience, at 15,000, 25,000, 50,000, 100,000 and 500,000 inhabitants; the interurban roads being, as they should be, in a class by themselves.

Without seeking to enter into the details of the peculiarities distinguishing each group of cases, much less those of the individual cases cited in illustration of particular facts, some of the general conclusions reached by the author may be briefly adverted to. He points out that the majority of roads in localities of less than 25,000 inhabitants have been capitalized at figures much in excess of the present cost of duplicating their tangible assets, and hence that they will frequently fail to permanently earn the interest on their mortgage indebtedness. As investments, none of them are regarded as worthy of consideration by other than local capitalists, who are able to give personal time and care to the management of the properties. The systems throughout the United States falling within this category number nearly 400. The author expresses the opinion, which seems to be amply justified by the figures of his table, that in cities of from 25,000 to 35,000, and from that up to 50,000 inhabitants, with systems constructed according to the best engineering practice of to-day, an electric line can rarely be operated for less than from 70 to 75 per cent. of the gross passenger income. A construction and equipment cost of $12.50 to $15 per capita of population served, is regarded as the highest amount that can be regarded as safe in communities of this size. For example, a 12-mile system in a town of 30,000 can be built for $250,000 at current prices, and ought to be able to earn $75,000 gross and $18,750 net per annum. The return on the investment would therefore be about 7.5 per cent. which, according to the author, is roughly the average intrinsic earning capacity of this class of properties. In larger communities, up to those of say, 100,000 inhabitants, the same considerations apply, although the increasing gross earnings per mile of track without materially greater first cost, make it possible in many instances to earn from 10 to 15 per cent. net on the actual value of tangible assets. In cities of from 100,000 to 500,000 inhabitants, in which the magnitude of the interests involved insure the continued employment of the best obtainable managing ability, a net earning power of from $2.75 to $3.50 per capita is not an unreasonable estimate. The actual cash cost of building and equiping a new system in these cities will rarely be less than $50,000 per mile of track, so that while liabilities of from $15 to $25 per capita are not excessive, larger amounts may well be regarded with suspicion. Most of the interurban systems reported in the tables appear to be very good properties, although the author points out that many schemes of this kind of very doubtful value are being urged upon capitalists in more recent days.

If the deductions of the author in reference to the admissible capitalization of street railways per capita of population served are anywhere near correct, and it certainly does not look as if they were unnecessarily conservative, there would seem to be abundant reason for uneasiness in financial circles as to the safety of the vast sums of money which have been diverted into this field of investment during the past five years. A table published in the *Street Railway Journal* of July, 1895, presumably compiled by Mr. Higgins from later returns than those embodied in the work under review, reveals some tendencies of street-railway financiering which are, to say the least, somewhat startling. While the capital liabilities in the state of Massachusetts, amount to no more than $56,300 per mile of track, which, under the conditions there prevailing, perhaps cannot be regarded as excessive, those in Rhode Island are put at $146,800, New York, $207,100, and New Jersey, $129,400. The average of all the roads in the United States, good, bad, and indifferent, is no less than $95,600 per mile of track, an amount which must be certainly three or four times the actual value of the tangible assets. Of course, it is obvious that in a business in which the operating expenses amount to something like 75 per cent. of the gross-earnings, such an extensive inflation as that above indicated cannot but ultimately bring about disastrous results. In setting forth the conditions which determine the profitableness or the reverse, of a street-railway system, and in giving information which shall enable the ordinary investor to distinguish the good from the bad, we think Mr. Higgins has performed a notable service to the public; a service which, moreover, has fortunately been rendered in good season, inasmuch as there is good reason to believe that a large proportion of the securities heretofore issued upon the class of properties under consideration have not yet come into the hands of the ultimate small investor, but still remain in more or less speculative channels, awaiting more favorable conditions for marketing than those which have prevailed for the past two or three years. The new stock issues, few of which represent actual cash investment, are chiefly held by promoters, "syndicates" and "traction-companies," as a source of future rather than present profits. The grave question is, to what extent has there been an actual over-capitalization of earning power, necessitating ultimate reorganization and a ruthless scaling down of nominal values? The information given in this work will in many cases, enable the intending or actual investor to determine this point for himself, in respect to any particular system.

Although it is scarcely six months since this work was written, the rapid progress of events has thrown much new light on the condition of some of the particular properties discussed by the author, and hence it is much to be hoped that the present edition may meet with sufficient appreciation and favor to encourage the author to prepare a revised and extended edition at no distant day.

F. L. P.

MORE PRAISE FOR THE "DATA SHEETS."

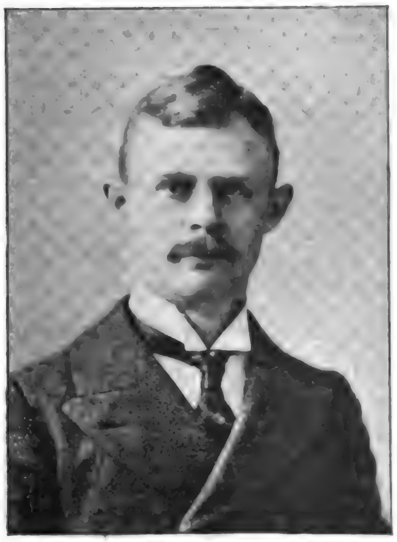
Will N. Eichberg, Superintendent Mutual Light & Power Co., Chicago, Ill., says: "I consider your 'Data Sheets' of the greatest value to all in the business, and would take one years to accumulate the same." Chas. Timberlake, with the Indianapolis Electric Co., telephone manufacturers, remarks: "I think it is a good thing."

THE TROLLEY IN BERLIN.

The Municipal Council of Berlin, Germany, have sanctioned the building of a trolley road and have specified the Thomson-Houston system to be used. The line to be equipped is part of the Grosse Berliner Pferdeisenbahn Gesellschaft, and the work will be done by the Union Elektricitäts-Gesellschaft of Berlin, who are the agents for the Thomson-Houston apparatus.

PERSONAL.

H. T. EDGAR.



Harry T. Edgar.

It may be doubted whether any younger man than Mr. Harry T. Edgar has ever been made general manager of a large electric light company, in a leading city. Mr. Edgar was appointed general manager of the Georgia Electric Light Co. of Atlanta, Ga., on Jan. 1, 1893, and became secretary and general manager in 1894. He was born in New Jersey in 1869, was educated at New Brunswick, N. J., and began work in the electrical field at the Edison station in that city, under Mr. Wilson S. Howell as superintendent. In 1886 he joined the Engineering Department of the Edison Electric Light Co. of which Mr. J. H. Vail was then general superintendent. He was transferred to the various similar departments of the Edison United Mfg. Co., the Edison General Electric Co. and the General Electric Co., enjoying opportunities for a singularly large and wide experience. He was a meter expert for the Edison Electric Light Co. and installed chemical meters in New Orleans, Erie, Pa., Easton, Pa., Scranton, Pa., Canton and Dayton, O., Winnipeg, Man., and Toronto, Can. In New York City he was employed for two years on the local Edison underground system; and he also installed the meter system and built the boards for Cincinnati and Milwaukee. Another important branch of work intrusted to him was that of making a technical canvass of the cities of Omaha, Sioux City and Buffalo, with a view to the introduction of the Edison system. It was as a result of all this work, faithfully and intelligently done, that Mr. Edgar was selected for Atlanta.

A few words as to the station under Mr. Edgar's care will not be out of place. The plant of the Georgia Electric Light Company consists of two McIntosh and Seymour engines 500 H. P. each, one Harris-Corliss 700 H. P., one Greene 900 H. P., and one Armington & Sims 125 H. P. engine; total 2,725 H. P. There are 19-50 light arc dynamos, T. H., 2-125 light arc dynamos, Wood, 3-2000 light alternators, 1-1300 light alternator, 1-1000 light alternator, 2 M. P. 100 K. W. power, 1 M. P. 200 K. W. power. The plant, in addition, furnishes power to the Atlanta Consolidated Street Railway Company from 4 M. P. 80 K. W. power generators; and has a contract for power with the Atlanta Electric Railway Company. The company is operating 625-2000 C. P. street arc lamps, 560-75 C. P. street incandescent lamps, 90 commercial arc lamps, 125 alternating arc lamps, 14,000 incandescent lights, and 500 horse power in motors. It has just bought one new 800 H. P. cross compound Greene engine and one 9,000 light alternating current machine from the General Electric Company. It expects to have same installed and running by November 15th. The company has orders on its books to wire for 2,500 additional lights.

Mr. Ernest Thurnauer, the well-known manager of the French Thomson-Houston Co., is again a visitor to the States. Mr. Thurnauer's stay on this occasion is a short one, as he is seeking rest and recreation in a trip around the world. We can only hope that Mr. Thurnauer will be everywhere received with that open hearted hospitality which he lavishes on all who have the good fortune to meet him in Paris.

Mr George K. Hooper, for three years agent and engineer of the Abendroth & Root Mfg. Co., has resigned, to accept a responsible position with the Deering Harvester Co., of Chicago.

Dr. Leonard Paget, late electrician and chemist of the Electric Power Storage Co., has severed his connection with that company and will now devote his attention to electrical contracting work and to all matters relating to electro-chemistry and electro metallurgy, in both branches of which he has had an extended experience. His offices are at 166 Elm St., New York.

LEGAL NOTES.

A BRIEF HISTORY OF THE DOUBLE CARBON LAMP LITIGATION.

In view of the recent decision on double carbon lamps, in Chicago, by Judge Showalter, in favor of the Western Electric Co. in the suit brought against it by the Brush Electric Co., it may not be inopportune to give a brief recapitulation of the history of double lamp infringement suits.

The first suit brought upon the Brush double carbon lamp patent No. 219,208, was that against the Fort Wayne Jenney Company upon the Cain lamp, which was then manufactured by the Fort Wayne Company. This suit was decided in the latter part of 1889, and was begun, we believe, in 1886 or early in 1887. A decision in favor of the complainant was rendered by Judge Gresham at Indianapolis, the only defense in this case being the invalidity of the patent. Infringement was practically admitted. Suit was also brought against a user of the Indianapolis Jenney Electric Company's double carbon lamp, which was also practically admitted an infringement, and as a matter of course a decision was reached in favor of the complainant.

In 1887, suit was begun against the Western Electric Light Company, of Toledo, Ohio, which used the Scribner lamp manufactured by the Western Electric Company, under patent No. 418,758. Here an entirely new question was brought up, but the Court notwithstanding reached a decision finding the defendant's lamp to infringe. This was in August, 1890. Prior to that time suit had been begun in the Northern District of Illinois against the Western Electric Company, and upon the finding of the Court in the suit at Toledo, Judge Gresham granted a preliminary injunction upon this same Scribner lamp which had been found to infringe in the Toledo case.

In getting the Brush double carbon lamp patent sustained, the Brush Company's counsel and experts had limited the claims to a single lamp controlling two sets of carbons. After the decision in the Toledo case, and after Judge Gresham had granted a preliminary injunction in the suit against the Western Electric Company in Chicago, the Western Electric Company began the manufacture of double lamps which, instead of being single lamps each controlling two sets of carbons, were two separate lamps enclosed in one case, each separate lamp controlling one set of carbons. The Brush Electric Company attempted to get a judgment of infringement against these devices by making a motion for attachment for contempt of court. This motion was made and argued before Judges Gresham and Blodgett in February, 1891, and denied. After this motion for attachment for contempt of court had been dismissed, a new bill was filed by the Brush Electric Company against the Western Electric Company upon the two forms of lamp above described, in which each set of carbons was controlled by a separate electro magnetic mechanism; and the proofs in the two cases, the one involving the original lamp which had been adjudged to infringe at Toledo and the other involving the so-called twin lamp above described, have been proceeding for the four or five years since that time. The two cases were finally brought to hearing on May 1st last, and resulted in the decision of Judge Showalter limiting the Brush patent and finding that neither the original Scribner lamp involved in the Toledo case nor the twin-lamp involved in the subsequent suit, infringed the Brush patent.

The Brush Electric Company has filed bills against a large number of users of double carbon lamps, which, however, have not yet been brought to trial. There are some fifteen or more of these cases, some of them municipalities in various parts of the country.

Other litigation against other manufacturers of double carbon lamps has been proceeded with in other circuits, and in some instances settlements have been made, the defendants being influenced thereto by the opinions of the courts in the various cases which had been contested. The Brush double carbon lamp patent expires September 2, 1896.

A RESULT OF THE PENNSYLVANIA TROLLEY DECISION.

A curious and natural result of a recent decision of the Supreme Court with regard to electric railways was shown in the case of one of the suburban lines of Philadelphia. The line was built, but the Supreme Court, having decided that electric railways could not be constructed without the consent of all the property owners adjoining, five property owners in a stretch of 12 miles have objected and prevented the operation of the road. In this dilemma the managers have purchased dummy steam cars, and are going to operate it in that way. This method is cumbersome and most objectionable, furnishing the minimum accommodation with the maximum of nuisance, and yet, under the decision of the Supreme Court, it is perfectly legal to run the noisy, clumsy dummies, with or without the consent of property owners, while cleanly, handsomely equipped, swift electric cars cannot be moved over the line until the last objector withdraws his opposition.—*Reading, Pa., Herald.*

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JULY 30, 1895.

Accumulators:—

Secondary Voltaic Battery, L. Epstein, London, Eng., 543,680. Filed Jan. 5, 1895.

A negative plate made of wire gauze electrolytically coated with zinc, positive plates inserted between the negative plates, and revolving agitators of insulating material interposed between the opposed surfaces of the positive and negative plates.

Alarms and Signals:—

Railway Signalling System, T. B. Dixon, Henderson, Ky., 543,591. Filed November 17, 1893.

Electrical Railway Signalling System, T. B. Dixon, Henderson, Ky., 543,592. Filed October 5, 1893.

Register, T. B. Dixon, Henderson, Ky., 543,593. Filed February 14, 1894.

Relates to that class of registers which are used in connection with automatic railway block-signal systems to register each wheel of a train as it passes into the block, and to cancel the record as the wheel passes out of the block.

Electrical Railway Signalling System, T. B. Dixon, Henderson, Ky., 543,594. Filed July 10, 1894.

Electrical Railway Signalling System, T. B. Dixon, Henderson, Ky., 543,595. Filed August 20, 1894.

Electrical Railway Signalling System, T. B. Dixon, Henderson, Ky., 543,596. Filed August 20, 1894.

Track Instrument, T. B. Dixon, Henderson, Ky., 543,597. Filed August 20, 1894.

Relates to a signalling system.

Signalling on Railways and Means Therefor, Edwin Blakey, Bradford, Eng., 543,721. Filed June 11, 1894.

Designed to be employed in conjunction with the ordinary single needle block system.

Railway Signalling, J. G. Schreuder, Edgewood Park, Pa., 543,785. Filed March 28, 1894.

Switch and Signal Mechanism, J. V. Young, Boston, Mass., 543,798. Filed August 29, 1894.

Distribution:—

Manhole for Underground Conduits, J. F. Cummings, Detroit, Mich., 543,613. Filed November 6, 1894.

Details of construction to afford safe and convenient connections.

Dynamos and Motors:—

Starting or Stopping Device for Electric Motors, J. P. B. Fiske, Alliance, Ohio, 543,523. Filed November 14, 1894.

The torque of the movable field magnet frame automatically operates a shoe, and causes it to pass over the contacts of the rheostat.

Device for Automatically Operating Brakes and Rheostats, J. P. B. Fiske, Alliance, Ohio, 543,524. Filed December 6, 1894.

Similar to above.

Electric Motor and Brake Mechanism Therefor, J. P. B. Fiske, Alliance, Ohio, 543,525. Filed February 9, 1895.

The counter torque of the field is utilized to operate a brake.

Electrometallurgy:—

Process of and Apparatus for Treatment of Precious Metals, Edwin J. Fraser, San Francisco, Cal., 543,546. Filed Nov. 25, 1893.

Process of Extracting Precious Metals from Their Ores, M. Crawford, Colorado Springs, Colo., 543,673. Filed October 29, 1894.

Consists in exposing a cyanide solution to the action of an electric current in the region of the anode only, until considerable portion of said solution is converted into cyanate by electrolytic action, and employing said solution as an agent for lixiviating the ore.

Process of Extracting Precious Metals from Their Ores, M. Crawford, Colorado Springs, Colo., 543,674. Filed December 8, 1894.

Similar to the above.

Apparatus for Extracting Precious Metals from Their Ores, M. Crawford, Colorado Springs, Colo., 543,675. Filed December 14, 1894.

Relates to above.

Electrodeposition of Alloy, H. J. Altman, New York, N. Y., 543,824. Filed April 12, 1894.

Consists in forming a bath or solution containing a chloride of platinum and the sulphate of the other metal, and an anode composed of an alloy of the metals to be electrodeposited.

Lamps and Appurtenances:—

Electric Arc Lamp, S. E. Nutting, Chicago, Ill., 543,502. Filed April 5, 1894.

A constant potential alternating current lamp. The magnet and armature are so related that the induced counter electromotive force of the magnet varies with the changes of position of the armature.

Electric Arc Lamp, C. E. Harthan, Lynn, Mass., 543,729. Filed November 21, 1894.

A spring is arranged to progressively assist the action of the core when the arc is first struck. Intended for alternating arc lamps.

Miscellaneous:—

Electrical Controlling System for Elevators, C. O. Mailloux, New York, N. Y., 543,495. Filed May 28, 1895.

Arranged so that it is impossible for any one to run the car so long as any of the landing doors are open or to open any of the doors so long as the car is running. No one can obtain control of the car while it is being operated by another.

Reactive Coil, E. E. Stark, New York, N. Y., 543,564. Filed February 21, 1894.

Details of construction

Internal Illuminator and Probe, W. E. Dow, Braintree, Mass., 543,616. Filed February 16, 1895.

Electric Soldering Iron, F. B. Rae, Detroit, Mich., 543,654. Filed September 18, 1894.

An electric soldering iron for cans, etc., comprising a fixed standard or rod, upon which the soldering iron is pivoted and turns, with means for revolving it about the fixed standard in the circular path.

Electric Clock Winding Mechanism, W. E. Scales, Everett, Mass., 543,707. Filed November 12, 1894.

Hot Box Indicator for Railway Cars, Lyndon, Athens, Ga., 543,743. Filed December 13, 1894

A mercury thermostat arrangement.

Electric Heating Rug, J. R. Davis, Parkersburg, W. Va., 543,800. Filed July 11, 1894.

Watchman's Time Recorder, George F. Ransom, Milwaukee, Wis., 543,655. Filed Sept. 4, 1894.

Elevator, Norton P. Otis, Yonkers, N. Y., 543,680. Filed March 2, 1893.

Overhead Travelling Crane, Thomas R. Morgan, Sr., Alliance, Ohio, 543,557. Filed Sept. 10, 1894.

Railways and Appliances:

Electric Brake, W. B. Potter, Schenectady, N. Y., 543,851. Filed March 23, 1895.

Couples the cars so that by the rupture of the coupling a circuit will be completed through the brake magnets upon the portion of the train separated from the motors.

Electric-Brake Shoe, William B. Potter, Schenectady, N. Y., 543,653. Filed March 30, 1895.

Electric-Car Brake, George B. Damon, Lowell, Mass., 543,544. Filed April 9, 1894

Electric Trolley, G. W. Hooper, Rochester, N. Y., 543,539. Filed September 11, 1894

Four-Motor Reversing Switch, F. E. Case, Schenectady, N. Y., 543,670. Filed May 15, 1895

Improvement on patent No. 524,396. Intended for electric cars.

Telephones:—

Signalling Apparatus for Telephone Exchange Circuits, J. J. O'Connell, Chicago, Ill., 543,559. Filed May 14, 1895.

A clearing out signal, consisting of an incandescent lamp, which lights up and extinguishes.

Transmitting and Receiving Attachment for Telephones, H. W. Libbey, Boston, Mass., 543,626. Filed October 9, 1894

Telephone Exchange, W. Y. Shibata, San Francisco, Cal., 543,708. Filed November 24, 1893.

Details relating to an automatic exchange.

Telephone, N. L. Burchell, Washington, D. C., 543,798. Filed October 29, 1894.

The arrangement is such that the carbon granules are agitated whenever the instrument is used.

AUTOMATIC BASEBALL BY ELECTRICITY.

One of the most ingenious and interesting of the recent applications of electricity is its use in the reproduction on the stage of a theatre exactly as played at the same time on the regular grounds, of a baseball game between any two of the National teams contesting for the pennant. Curious as it must seem to all steady playgoers, the first series of performances of this character is now being given on the classic boards of Palmer's Theatre, this city; but while the thing strikes one at first as rather curious, it is certain that heartier applause could not possibly greet any "legitimate" production. "Automatic Baseball by Electricity" is the invention of Mr. Frank M. Chapman, long time connected with Mr. Joseph Jefferson's Company, and his three financial associates are the three sons of the famous actor, Thomas, Charles and Joseph, who are giving the inventor also their active co-operation in matters of management and detail.

The whole stage at Palmer's is set out as a baseball field, with green baize turf and a strictly accurate "diamond," whose only novelty is that it abounds in vampire traps, through which the players disappear when put out, instead of returning to the bench with dust on their clothes and loud protests on their lips. This innovation is a decided improvement. The path of the diamond from base to base is grooved, for travel, and the spot for the catcher is also grooved in order that he may close in after two "strikes." All the players have their proper positions on the big field, and are represented by dummy marionettes, true to the life and about 3 feet high. Besides the fielding team, and the man at the bat or those on bases, three men of the in team are seen on a bench waiting their turn; two coaches gesticulate wildly on right and left field, and back of the pitcher's box is an umpire who calls game and waves his arms quite à la mode. Moreover the batter at the home plate is provided with a bat which he flings down with a genuinely "sickening thud" when he starts for first base. Around the field is a drop representing a big fence, with the usual advertisements, and at the wings is the grand stand of which the real spectators in front are supposed to be occupying a portion. The field is sloped gently upward so that it is in full view. Along the footlight edge runs a scoring board, which gives the figures not only of the game in progress but of the other League contests.

But where is the ball? The answer to this discloses Mr. Chapman's further ingenuity, which is of a very high order. Each fielder, including pitcher and catcher, has a white incandescent lamp in his hand, which lights up only when he has the ball, so that one always sees and knows where the ball is. When it leaves the pitcher's hand, his white light goes out and the white light is seen in the catcher's hand. If the pitcher's hands are above his head, it is "one ball." If the light shows with his hands at his waist it is a strike. If the batsman hits the ball foul, it is shown within the foul line by a green light at the spot. If the batsman does his duty, and hits the ball plumply, its track across the sward is shown by a series of white lights bursting into momentary gleams one after the other across the baize. If the ball is a "fly," its course through the air is marked by a series of white lights strung from the flies. If a fly drops safely in a fielder's hands, his white light breaks forth boldly. If he fumbles, the light flickers, and when the ball drops a red light shows at his feet, indicating the "error." It will be readily understood that a batter can thus be followed around the diamond until his course is stopped by the white light breaking forth in the fielder's hands at the base he is striving to reach. If he gets there safely, the light goes out. If he is too late, the light stays, and he can realize to the eye the wish that the earth would open and swallow him. Each batsman follows the grooved track on wheels which

move his legs so that he seems to be running, and of course he can be seen in the very act of trying to steal the next base.

Nor is this all. The umpire has a white light, so that when a ball is hit out of play, he is seen to furnish a new one which, of course, shows up in the hands of the pitcher just as quickly as the circuit can be switched. The actual movements seen on the field are supplemented by the work of an elocutionist who repeats the messages coming directly from the game and received by an ordinary sounder set. It is no exaggeration to say that one sees or feels the whole game, except the rows with the umpire—which are not part of the game and can well be dispensed with.

The whole process is governed and operated from a simple central switchboard in the wings, and supplemented by two large billboards at the side of the game, giving a list of the players and their positions. By means of a series of multi-point switches and snap push buttons, all the lights are flashed and all the movements are indicated; the same means also serving to change the color of the teams at the close of each inning. At the present time, Mr. Chapman has his men on bases and the catcher manipulated by boys under the baize field, to whom he signals by concealed flash-light code; but he has worked out the whole method of automatically moving each figure by electric motor. The regular street lighting 110 volt circuit is used on all the lamps, with the utmost ease. The switching and control board is not three feet square, and can be carried comfortably by one man, so that the governing mechanism has evidently been reduced to a minimum. The umpire and coachers are also moved by strings so as to go through actions that are natural. All told, 50 incandescent lamps are used in the game.

The prices of admission to this spirited and really exciting electric pantomime are only 25 and 15 cents, and we heartily recommend our readers to take in the show, whether baseball cranks or merely electrical enthusiasts. They will be well repaid for their time and trouble, and will see in operation an invention which is so clever and full of applicability, it cannot stop short even at the thrilling simultaneous reproduction of the National Game. We are glad to note that the show has been drawing large crowds.

TERMS AND CONDITIONS OF THE HORSELESS VEHICLE RACE, CHICAGO TO MILWAUKEE.

We give below, in response to a great many inquiries, the full terms and conditions of the great horseless vehicle race, organized for next November by the *Chicago Times-Herald*:

First prize—$2,000 and a gold medal, the same being open to competition to the world.

Second prize -$1,500, with a stipulation that in the event the first prize is awarded to a vehicle of foreign invention or manufacture, this prize shall go the most successful American competitor.

Third prize—$1,000.

Fourth prize—$500.

The third and fourth prizes are open to all competitors, foreign and American.

It must not be supposed that in this contest the question of speed is the only requisite to be considered. It would be possible for an ingenious mechanic to construct a machine with which he could easily outstrip all others in this contest, and yet that device would be of no utility and the outcome of no value to the world from a practical point of view.

It is the earnest desire of the paper that this contest shall add to the sum of our mechanical knowledge in this, the new branch of the science of transportation. In this spirit the following rules are laid down for the guidance of all who may desire to enter into the competition:

1. The date of the contest will be Saturday, Nov. 2, 1895. The judges may postpone the contest if in their judgment the state of the weather or the condition of the roads will not permit a fair trial.

2. The contestants will start at some point in or near the City of Milwaukee and will finish at some point in or near Chicago, not farther south than the south limit of Lincoln Park.

3. The contest is limited to automatic carriages, or, as they are more commonly known, "horseless carriages." There will be eligible to competition any and all vehicles having three or more running wheels, and which derive all their motive power from within themselves. No vehicle shall be admitted to competition which depends in any way upon muscular exertion, except for purposes of guidance. Competing vehicles which derive their power from petroleum, gasoline, electricity or steam, and which are provided with receptacles for storing or holding the same, will be permitted to replenish the same at Waukegan, Ill., and at Kenosha, Wis., but at no other points.

4. No vehicle shall be admitted to competition unless it shall comfortably carry not less than two persons for the entire distance, one of whom may have charge of the vehicle and the manipulation of the same.

5. No vehicle shall be admitted to competition except that it be free from danger, not only to its occupants but to spectators and the public users of the highway. The judges at their discretion may debar any vehicle which from its construction gives evidence of defects which would render the adoption of its type an evident impossibility.

6. For the purpose of limiting the contest to vehicles of practical utility a preliminary test of all vehicles entered for competition shall be held by the judges on or about Saturday, Oct. 26, under such rules as the judges may determine on, and for such a distance as they may decide. At this test the judges may debar such constructions as in their opinion do not possess features entitling them to further consideration. It is stipulated, however, that all motor vehicles which won prizes or honorable mention in the Paris-Rouen contest of 1894 or in the recent race between Paris and Bordeaux shall not be compelled to compete in the preliminary test, but shall be admitted upon proper application to the final competition on Nov. 2.

7. In making awards the judges will carefully consider the various points of excellence as displayed by the respective vehicles, and so far as possible select as prize winners those constructions which combine in the highest degree the following features and requisites, rating them of value in the order named:

A. General utility, ease of control and adaptability to the various forms of work which may be demanded of a vehicle motor. In other words, the construction which is in every way the most practical.

B. Speed

C. Cost, which includes the original expense of the motor, and its connecting mechanism, and the probable annual item of repairs.

D. Economy of operation, in which shall be taken into consideration the average cost per mile of the power required at the various speeds which may be developed.

E. General appearance and excellence of design. While it is desired that competing vehicles present as neat and elegant an appearance as possible, it should be assumed that any skilled carriage-maker can surround a practical motor with a beautiful and even luxurious frame.

8. All vehicles must be entered for competition not later than Sept. 15, 1895. All applications should be addressed "Editor Horseless Carriage Contest, Room 511 Times-Herald Building."

The date of the contest will not be changed from Saturday, Nov. 2, except for extremely bad weather or condition of the roads.

In answer to many inquiries as to how the carriages will be started it may be assumed that the judges will start them one or two at a time, keeping accurate record of the exact time each carriage passes the starting point, the same as is the rule in a yacht race. The various vehicles will be designated by numbers conspicuously displayed and a record will be kept of the time at which they pass various points along the road. Other less important rules will be formulated and officially announced by the judges at the proper time.

While two persons are fixed as the minimum number of passengers carried, the judges will undoubtedly take into consideration the handicap imposed on vehicles conveying a greater number.

MANUFACTURING ELECTRIC MEN AT TONAWANDA, N. Y.

And now Niagara Falls will probably be the location of a factory for turning out electric men; not mesmerists or svengalis, but automatons that will run by electricity. They have built one up at Tonawanda at the Gillie, Goddard & Co.'s plant where they turn out merry-go-rounds. This man has been on the streets of that town. It is an invention of Philip Perew, who has secured a patent. The idea is by no means perfected. At present all the man is good for is to pull a cart about the streets of a city. The model that has been exhibited in Tonawanda to the delight of the populace and the honor of a certain soap is but a crude thing. The man clothed in continental uniform drags a heavy cart with some ease, while on the sides of the cart flaring signs exalt the glory of soap or pills, as the case may be. The model has been on the streets of Tonawanda, and it worked well. It was so alluring that the small boy flocked in such dense swarms that the policeman was summoned to chase him away. The man was about seven feet tall, and was modeled after William F. Sheehan. The cerulean of its eyes matches that of its famous counterpart exactly. The men, though, that the firm will make will be run by storage batteries, and have a phonograph. The phonograph can say whatever is desired. It can expound the virtues of patent medicine or be used for political campaigns. So, at present, the only form of labor threatened by the invention is that of the sandwich man and that of the campaign speaker. The men and carts that are used to extol medicines will be very fine pieces of mechanism, and can be geared to go as fast as anyone desires. By simply turning on a current, the man, his eyes still fixed on eternity, can hump down the street at a rate far exceeding any bicycle. The limit has not been reached. In course of time it may be that men can be constructed to do almost anything, and the laboring-man can sit around and smoke 25 cent cigars while a multitude of electric men do all the work. This will not occur for some years yet, but, no one can say where it will stop.—*Niagara Falls N. Y. Gazette.*

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

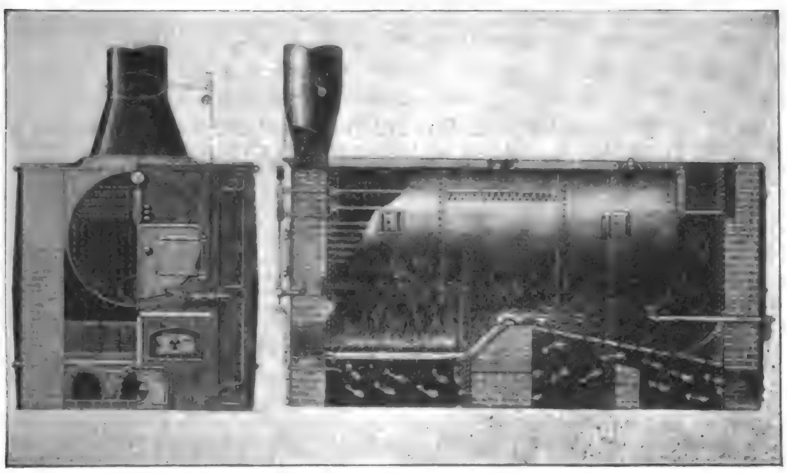
THE WEITMYER STEAM BOILER FURNACE.

We have received from the Harrisburg Foundry and Machine Works, of Harrisburg, Pa., a neat little catalogue descriptive of the Weitmyer steam boiler furnace, manufactured by them. The furnace can be applied to existing boiler setting without expensive changing, and is claimed to reduce the expenditure of fuel at least 15 per cent. The appliance is inexpensive and simple and gives almost perfect combustion.

As the accompanying engraving shows, its arrangement is such that all air for combustion is taken in at the rear of the setting and under the flame-bed, and thus, becoming heated before being introduced to the furnace, aids combustion and also prevents the chilling of the boiler, which occurs when the draft is taken at the front end.

A portion of the heated air, after passing through the bridge wall arches into the ash pit, and is allowed to pass to the top of the bridge-wall through suitable passages. It is this air which supplies the necessary oxygen to ignite the gases, the very pith of the fuel, which would otherwise escape unconsumed. In addition to the stated economy of 15 to 20 per cent. in fuel, an inferior grade of coal can be advantageously used; although the setting does not insure the consumption of dirt. This furnace is highly spoken of in letters from a large number of manufacturing firms, who are unanimous on the score of its economy and easy firing

At a test of the steam plant of the New Bedford and Fair Haven Traction Company, New Bedford, Mass., for the determination of working conditions and economy, the following results were obtained: Engine: Harrisburg "Ideal" tandem compound, 14 and 24 x 16 in.; indicated average horse power, 170 95; pounds of water per pound of coal, 12.19; pounds of water from and at 212°, 13.12. This shows remarkably high evaporation per pound of fuel.



The Weitmyer Steam Boiler Furnace.

THE MICHIGAN ELECTRIC CO. TO REPRESENT GENERAL ELECTRIC.

The Michigan Electric Company, of Detroit. Michigan, has recently completed an arrangement with the General Electric Company, and the Edison Illuminating Company, of Detroit, covering the selling agency of General Electric machinery and supplies in Michigan. This arrangement covers the entire line of General Electric manufactures, including lighting generators, motors, incandescent lamps, and all their various lines of machinery and supplies.

The Michigan Company which was incorporated about two and a half years since has during that period grown rapidly, and today has one of the largest and best equipped supply houses in the country, and is making itself felt as a strong competitor for the supply business.

The Michigan Company has, however, made an exception in the matter of overhead railway material in which line it will continue to manufacture and sell the "Michigan" hangers, etc. which have obtained a most satisfactory recognition among the street railway companies. The Michigan Company has recently engaged Mr. H. E. Baldwin, formerly representing the General Electric Company in Kansas, Missouri, and Oklahoma, who will look after the State trade, and Mr. L. J. Baldwin will hereafter be in charge of the sales at the Company's headquarters.

PROPERTY OWNERS AS STOCKHOLDERS AT ORANGE, N. J.

The recently-organized Freeman Street Improvement Company of Orange Valley, proposes to improve the street, and incidentally to build a trolley road from the Highland Avenue Station of the Morris and Essex Railroad, in a stright line, through Freeman Street, up the side of the Orange Mountain, with a temporary terminus at St. Cloud.

The capital stock of the new company is placed at $100,000, and all the stockholders will be property owners along the line of Freeman Street, no other persons to be eligible for membership in the corporation, and the stock to be divided on a pro rata basis, according to the benefit conferred in building the road. The incorporators of the company are Victor N. Savale, Christian H. Heckel, J. Henry Fieldler, and John J. Barry, and the officers are: President—John Davis; Vice President—Frans Berg; Secretary and Treasurer—Robert D. Colins.

ADAMS MOTOR AND STURTEVANT BLOWER.

We illustrate in the accompanying engraving a direct connected electric motor designed by Mr. Alton D. Adams, and a steel pressure blower built by B. F. Sturtevant Co., both of Boston.

The motor delivers 4 H. P. at a speed of 500 R. P. M. to a 60 inch blower, the blast wheel being mounted on the extended armature shaft. This motor explodes the idea that slow speed at moderate cost can only be attained by means of multipolar magnets and toothed armatures, as its field magnet is of the bipolar, forged iron type and its armature has a smooth core, while the total weight of the machine is only about 600 lbs.

Adams Motor and Sturtevant Blower.

A large number of machines of the above type have been designed for general and special purposes and have proved very economical to build and satisfactory in operation. Mr. Adams makes a specialty of the design of electrical machinery for manufacturers, particularly when unusual or exacting conditions are to be met.

NEW YORK NOTES.

Noll & Sibley, of the Postal Telegraph Building, have dissolved partnership, Mr. Noll retiring from the firm to engage in another line. The business will be conducted as before, at the same office, under the firm name of C. C. Sibley & Co.

Newburgh, N. Y.—The Edison Electric Light Company of this city has been consolidated with the opposition company, the Newburgh Electric Light and Power Company. The agreement includes the capitalization of the new company at $350,000. It is to be known as the Consolidated Gas, Electric Light, Heat, and Power Company of Newburgh.

Ford & Bacon, the electrical and mechanical engineers, of 208 Broadway, New York, have taken into partnership Mr. G. H. Davis, M. E., well known in the electric railway field. He is now in New Orleans in connection with the important railway work that the firm has in hand there. In addition to their New York office, and that at 421 Chestnut street, Philadelphia, the firm have now opened an office at 106 Camp street, New Orleans.

"THE AMERICAN FLAG."

The Electric Appliance Company report something startling in the dry battery line, having taken the General Western Agency for the American Flag dry battery.

The American Flag is claimed to be a decided step in advance in the manufacture of dry batteries, and is claimed to be superior in the volume of current and staying powers to the best open circuit batteries wet or dry. For telephone work it is said to be without an equal and is being extensively used. It is made in three sizes, filling the demand for a small pony battery or for a cell of extra large volume.

"A VERY HANDY THING."

Mr. E. T. Pardee, Mgr. Fort Wayne Electric Corporation, Omaha, Neb., writes: "Enclosed find 60 cents in stamps for which please mail me a morocco filing case for the Data Sheets. They are a very handy thing."

SALES OF GOULDS POWER PUMPS.

The Goulds Mfg. Co., Seneca Falls, N. Y., report the following sales of their Power Pumps: Archibald Rogers, Hyde Park on Hudson, N. Y.—one 8½" x 4" triplex pump for water supply. Capital Electric Light, Motor & Gas Co., Boise, Idaho,—one 1¾" x 2½" triplex pump for water supply. F. S. Blackhall, New York, —one ¾" x 2½" triplex pump for water supply. N. O. Railway & Mill Supply Co., New Orleans, La.,—four 5" x 3" triplex pumps. These pumps are operated by electric motor direct geared, all being mounted on one bed plate.

BELKNAP MOTOR CO.

The Maine State College electric light plant contract has just been awarded the Belknap Motor Company of Portland. The entire plant when completed will embrace one 15 and one 30 K. W. generater and several motors. The grounds will be supplied with four arc lights and the buildings with some 350 incandescent lamps. The Belknap Motor Co. have also just been awarded the contract for the new Rumford Falls Sulphite Paper Mill Co. electric light plant, calling for one 300-light dynamo and 250 lights installed.

THE TROLLEY SYSTEM IN ST. LOUIS.

A special correspondence of the *Evening Post* says:—A street railway president in this city remarked to-day: "The general introduction of electricity as a motive power has brought the officers and men of the street roads into closer relation than that they sustained under the old system. The primary cause of this is that it takes a higher order of intelligence to manage a trolley than it does to drive a mule. We have regular schools of instruction now which the men must attend, and this has brought the best of them forward. Ability is quickly detected by the questions asked and the interest taken, and wherever ability is found it is marked for promotion. One result of the school of instruction is that it is steadily reducing the percentage of accidents, and we expect to get this average below the old average on horse-car lines. Under the régime of the trolley drink has been absolutely prohibited among employees, and the well-remembered mulewhacker, whose capacity for whiskey was only exceeded by his versatility in profanity, is of the past. He has been weeded out. It is an indisputable fact that a far better class apply for the position of motorman and conductor than were in the habit of seeking employment as driver or conductor. It is a sort of scientific job now, and not a few fare-collectors have by dint of study and observation become pretty well-informed electricians."

A mammoth generator and twin engines are being placed in the power-house of a local company. Mr. Scullin, Vice-President of the line, when asked if it was made necessary by increased traffic, said: "Not altogether. In the winter we expect to use it as a stove. We intend to heat all our cars by electricity in future, doing away with the unsatisfactory coal-stove altogether."

NEW YORK NOTES.

Mr. G. E. Emmons has become the general manager of the Schenectady works of the General Electric Co.

Mr. J. T. Hambay, the general manager of the Beacon Lamp Co., of Boston, was in New York last week making many arrangements for the new business of this progressive concern.

A. De Ronde & Co. are meeting with marked success with their imported "Ship" cored carbons. Inquiries and orders are coming in fast, and all users seem to appreciate their sterling worth. The "Ship" carbon gives a steady, brilliant and economical light, and all users of carbons should procure a sample and give them a trial.

Mr. James G. Biddle, of Philadelphia, was a caller at this office last week. He reports an excellent inquiry and increasing demand for the instruments, batteries and other specialties he is handling.

Mr. M. E Baird, of the Eddy Elec. Mfg. Co. was in New York last week attending to some important new contracts. Eddy motors and generators are in great demand, and the company is making another increase in wages on September 1.

Messrs. Warren S. Hill and F. A. Wyman were two good Bostonians who found their way into the Engineer office last week and gladdened it with a budget of gossip and scores of new ideas, each worth at least $10, on electrical subjects.

In our recent description of the Baltimore tunnel power plant it was stated that the two fans used were of the Sturtevant pressure pattern. It seems that this was a slight error and we have been requested to state that the entire mechanical draft system including the two fans was designed by Mr. G. C. Hawkins.

The Anchor Electric Co., of Boston, have opened a New York branch office in the Havemeyer Building, New York, room 1105, in charge of Mr. A. B. Field, who has been connected with this company since its organization, and who is widely known to the electrical trade.

The Gold Street Car Heating Co., has been formed with a capital stock of $200,000. The president of the Company is Mr. Edward E. Gold, the well known inventor of car heating apparatus. The company will shortly bring out a new electric heater designed by Mr. Gold, which is said to be 25 per cent. more economical than any thus far produced. The company also does car heating on the Gold hot-water-system, having last winter equipped 200 cars on the Third avenue surface road in New York City. The company's offices are located at Bridge Store No. 6, at the corner of Frankfort and Cliff streets, New York.

PHILADELPHIA NOTES.

Francis Bros. & Jellett, incorporated, have taken out a permit for the placing of boilers, engines and dynamos in Horticultural Hall, on South Broad street. The work to be done comprises a complete equipment for heating, lighting and ventilation according to the most approved modern methods and will cost $25,000. The same firm have also secured permit to place tubular boilers, engine and electric light plant in the store and light manufacturing concern at 324 Market street.

WESTERN NOTES.

Morrison, Ill.—The Whiteside Harrison Telephone Company of Whiteside County has been formed at Morrison; capital stock, $6,000; to construct a telephone plant with connections in other counties; incorporators, Aaron D. Hill, Simon S. Greider and John B. Hill.

Kokomo, Ind.—The American telephone manufactured by the Laclede Electrical Company in this city, will be used in Logansport after October 1. The common council of Logansport at their last meeting revoked the franchise of the Harrison company and granted a franchise to E. B. Overshimer, representing the American company. The rates will be $18 per annum for business houses and $12 for residences.

Mr. J. R. Wiley, Chicago manager of the Standard Underground Cable Co. of Pittsburgh, reports that he is kept hard at work, and that his well known company are very busy. Mr. Wiley was recently in some of the other Western cities, and states that in every place he visited the prospects for a large Fall business were plainly visible.

Mr. J. J. Gates, General Manager of the Perkins Electric Switch Co. of Hartford, Conn., has just paid a visit to Chicago for a few days, where he was warmly welcomed by his many friends, who would have liked him to stay longer amongst them. Mr. Gates expects some good business in the near future both from the home end, and the Western territory, which is well looked after by their representative, Mr. G. W. Conover.

The Bryant Electric Co. is at work upon a new catalogue which it will issue this fall. Thos. G. Grier and Edward R. Grier, managers of the western office, Chicago, are busy on some new devices which will be placed upon the market in the near future. The Bryant marine switch, the most recent of the Bryant Electric Company's products, is used upon the two great American steamships, the "St. Paul" and "St. Louis," and, like all of the Bryant specialties, is a good substantial article.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
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COMMERCIAL PRODUCTS RESULTING FROM ACETYLENE—A NEW USE FOR THE ELECTRIC FURNACE.

BY

R. K. Duncan.

It occasionally happens that the easy synthesis of one chemical compound will unlock the door to the cheap commercial production of a room full of others. Such a statement finds exemplification in the recent remarkable production of the gas acetylene by heating merely a mixture of coal and lime (or charcoal and chalk) in an electric furnace, and throwing the resulting calcium carbide into water.

It is declared that calcium carbide (with water power to run the dynamos) may be made for less than twenty dollars per ton. Now from one ton of calcium carbide we may obtain 812 pounds of acetylene gas, costing less than two cents and a half per pound. This means, with certainty, the cheaper manufacture of innumerable substances used in the arts which may be made from acetylene by processes, which up to this time have been matters of pure chemistry, but which, on account of the lessened cost of acetylene, will now wage war with the older methods.

Acetylene, on being passed through an iron tube heated to dull redness, goes rapidly and completely into benzine, without the formation of any other product. Benzine is a product of prime importance, and is the base of thousands of organic substances, known as the benzine series of compounds. If the resulting benzine vapor be passed into strong nitric acid it is transformed into the oily nitro-benzine, and this, on treatment with hydrochloric acid and iron filings, goes easily into aniline. The ton of calcium carbide, or the 812 pounds of acetylene, results thus in somewhat less than 956 pounds of aniline. With the formation of aniline the road is now clear for the production of the innumerable dye substances whose varied hues have adorned the sisters and wives of the last twenty years, and whose discovery and preparation absorb the energies of an army of chemists.

Instead of passing into the dye substances, however, we may transform our aniline into carbolic acid. Thence it is but a step to picric acid, the foundation substance of many modern explosives. Or again, we may boil the aniline with acetic acid and we have transformed it into acetanilide or anti-febrin, the well-known fever specific. These substances, with their varied properties, come thus primarily from a lump of coal and a piece of lime.

Our protean acetylene, however, is capable of undergoing other changes just as startling. For instance, if it be passed through a tube heated to bright redness, it is changed to naphthalene, and naphthalene again will pass into a multitude of other valuable products. Or again, starting with acetylene, by the action of nascent hydrogen, we may change it into ethylene and finally into ethane. Ethylene, on being boiled with sulphuric acid and water successively, passes into alcohol, which is absolutely necessary to the production of an enormous number of economic substances. Ethylene on treatment with permanganate of potash readily oxidizes, first into oxalic acid, and then into formic acid. If the formic acid so obtained be treated with ammonia, and the resulting product heated to 180 degrees C., it is transformed into the deadly prussic acid. Acetylene in the mere presence of salts of mercucy unites readily with the elements of water to form aldehyde, so much used to-day in the production of essences and the manufacture of mirrors.

Starting with acetylene, by the agency of such cheap commercial products as muriatic acid, sulphuric acid, potash, ammonia, and a few others, it is possible to build up whole systems of dyes, medicines, essences, perfumes, poisons and explosives. The methods by which this may be accomplished are known matters of pure chemistry. They become commercially and economically practicable with the cheap synthesis of acetylene. Since this has been accomplished by the aid of the electric furnace and a mixture of lime and coal, we may expect to see the influence of acetylene ramifying throughout all organic chemistry. It has a utility out of all proportion greater than that derived from its peculiar light giving powers.

STORAGE BATTERIES IN TELEGRAPH WORK.

One is so prone to associate the storage battery with applications calling for heavy currents that one is apt to lose sight of a very important branch of electrical work in which cells of this character have proved of great usefulness. We refer to their use in telegraph, telephone, police and fire alarm and signalling work, in which fields they have already brought about little short of a revolution in the older methods. The advantages of a source of electric current other than the gravity battery were recognized as soon as the continuous current dynamo became a commercial actuality; and we need only recall the equipment of Siemens machines, which the Western Union installed in their New York main office as far back as 1876, to demonstrate the early appreciation of this fact.

Dynamo plants have been installed in a number of the larger central offices in the United States, but it must be evident that there are few places where it would pay to put in a generating plant for telegraph purposes alone. On the other hand, there are a large number of cities, whose telegraph business has heretofore required a large number of gravity cells, the original cost and the maintenance of which has always figured as a considerable item in the operation of the offices. If to this be added the fact that there are few, if any, cities in the United States below 5,000 inhabitants, which are not equipped with a central electric lighting station, it is apparent that a means is at hand for utilizing the storage battery as a substitute for the gravity cell. This fact is being gradually taken advantage of by the telegraph and railway companies doing large telegraph and signalling

work, with the result that we note a rapid increase in the employment of storage batteries.

A very simple calculation will show the advantages which the storage battery possesses for this purpose. Thus, if A = the voltage per cell of primary battery, B = the average working current, C = the cost of maintenance per cell (labor and material), then,

$$\frac{C \times 1{,}000}{A \times B \times \text{no. of hours per year.}} = \text{cost per kilowatt-hour of electric energy furnished by primary battery.}$$

If this figure be compared with the cost per kilowatt hour of the current furnished by local electric light companies (which averages about 20 cents per kilowatt hour), even after adding 15 per cent. for loss of current in the storage battery, the result will in most cases show the economy of using stored energy in place of the primary battery. Besides this, it may not be apparent at first sight that in the majority of cases the cost of primary cells is greater than that of a storage battery equipment of like capacity. If to this be added that the space occupied by the storage battery is $\frac{1}{6}$ of that of the primary, another important advantage will be established.

As regards the electrical superiority the electromotive force and internal resistance of the storage battery remain practically constant, while those of the gravity cell are constantly varying as the solution becomes saturated; again, troubles due to corroding connections, creeping salts, etc., met with in the gravity battery, are absent in the case of the storage battery.

These advantages have resulted in the equipment of some of the largest telegraph offices in the country with storage batteries. We have already in these columns given an account of the equipment of the Postal Telegraph Co.'s main office at Baltimore with storage batteries, which have now been in operation for about two years. The plant consists of 480 Chloride storage cells, none of which, we are informed, has required replacing since the original installation.

In order to give you some idea of the manner in which work of this character is carried out, we illustrate in Fig. 1 the plan adopted in the Western Union Telegraph offices at Atlanta, Ga., where 700 Chloride cells are now doing the work formerly done by 8,000 gravity cells. Of the 700 cells 344 are of 72 ampere hour, 172 of 50 ampere hour, and 17 of 25 ampere hour capacity, all used on main lines. Besides this, there are 12 cells of 250 ampere hour capacity, used exclusively for local circuits. The current from the central station is distributed at 500 volts, and in order to reduce it to 110 volts for the main batteries, a $7\frac{1}{2}$ horse power motor dynamo is employed, while the local batteries are charged by a 1 H. P. motor dynamo, which reduces the voltage from 500 to 16 volts. The two sets of main batteries are charged and discharged on alternate days, being divided up into 8 groups of 43 cells each, which are charged in multiple series, and discharged in series. The locals are also charged and discharged on alternate days.

Another very characteristic plant of this nature is that installed at the Central Railroad depot at Jersey City, N. J., the plan of which is illustrated in Fig. 2. In this

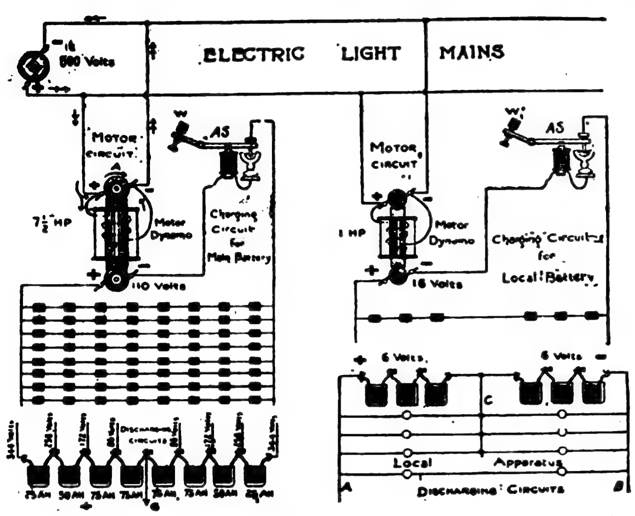


Fig. 1.

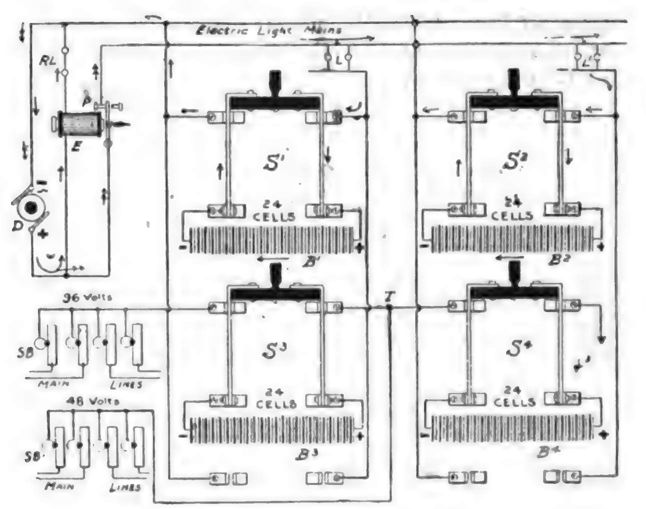


Fig. 2.

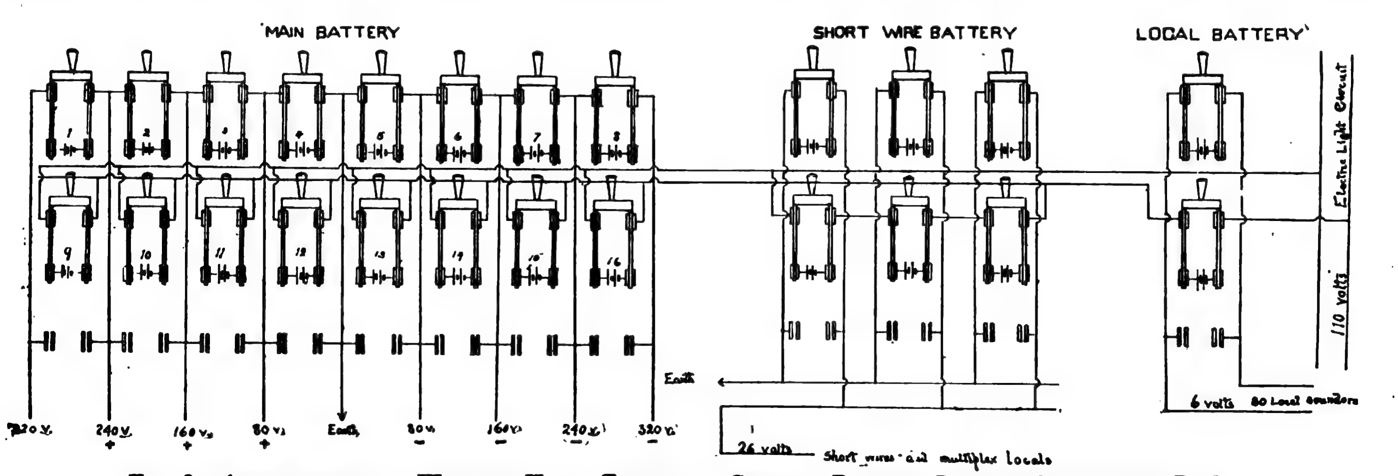


Fig. 3.—Arrangement of Western Union Telegraph Storage Battery Plant, Washington, D. C.

instance the charging is done from 110 volt electric light mains. The potential is reduced to that of the two storage batteries B[1] B[2] by means of the lamps L and L[1]. In this case also there are two sets of batteries and the connections are such that either 48 or 96 volts can be thrown on the main line as occasion requires.

The most important office now in course of equipment is that of the Western Union Telegraph Co. at Washington. Here 724 Chloride cells will be employed consisting of 398 cells of 50 ampere hour, 320 of 12½ ampere hour, and 6 of 125 ampere hour capacity. The arrangement of the installation is shown diagramatically in Fig. 3. As will be seen, the main battery of 640 cells is divided into 16 groups of 40 cells each, shown at No. 1 to 16 in the diagram. The latter also shows batteries 1 to 8 inclusive, discharging in series. Each section of 40 cells is tapped so that four different potentials of each polarity may

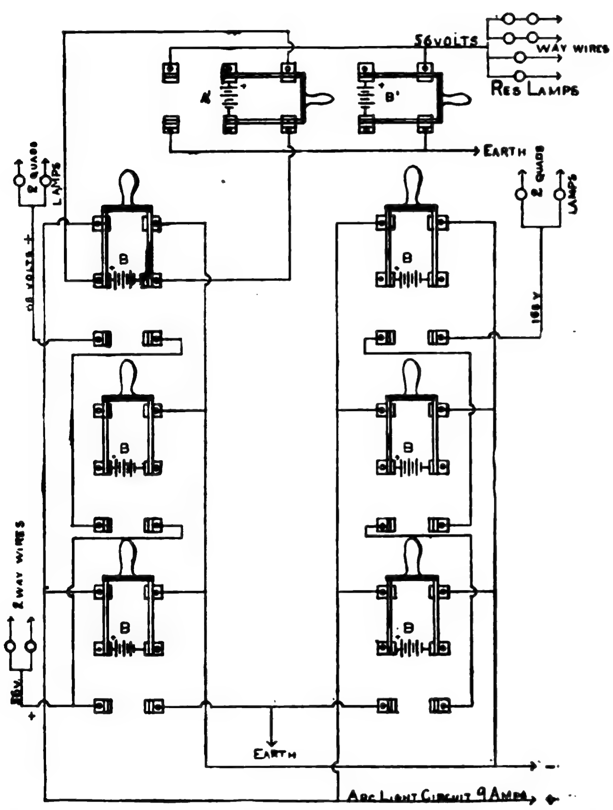


Fig. 4.—Telegraph Storage Battery Arrangement, Long Branch, N. J.

be used for telegraph circuits of various lengths. Batteries 9 to 16 are shown connected in multiple in the charging circuit.

Batteries 1, 2, 7, 8, 9, 10, 15, and 16 are of 12½ ampere hour capacity, while the remainder of the main battery is of 50 ampere hour capacity. The short wire battery consists of 78 cells of 50 ampere hour capacity divided into 6 batteries of 13 cells each, charged in series and discharging in multiple, as shown. The local battery consists of 6 cells of 125 ampere hour capacity. Three of these cells furnish current at 6 volts for 80 local sounders, connected in multiple. The other 3 cells are in the main charging circuit, as shown. It will be observed that both levers of the switches will reach the clips connected with the charging circuit, and that the batteries shown as charging can be discharged, and those shown as discharging, can be charged by throwing over all the levers. In the present instance, the batteries will be changed from charging and discharging every eight hours by means of rheostats. The charging current in each battery will be so regulated that the cells will be replenished in 8 hours. The 724 cells constitute the largest equipment of storage batteries thus far used in any telegraph office in the country, and will replace 7,300 gravity cells heretofore in use.

Another interesting application of a like nature is that recently put in operation at West End, Long Branch, N. J. Here 196 Chloride cells of 6 ampere hour capacity have been installed to take care of the heavy summer business. As shown in the accompanying diagram, Fig. 4, these have been divided into 7 groups of 28 cells each. The batteries are charged in multiple from an arc light circuit every night from 10 to 12 P. M., at the rate of 1½ ampere for each battery. The two batteries, A[1] and B[1], on the double lever switches are charged alternately on succeeding nights, being discharged in series. This arrangement has displaced 450 gravity cells.

Among the telegraph offices not mentioned above, equipped with storage batteries, are those at Allentown, Easton and Scranton, Pa., those at Pittsburg and Hartford, Ct., and Albuquerque, N. M., and various branch offices in New York.

Among the fire alarm systems which have been equipped with storage batteries, may be mentioned that at Philadelphia, where a Chloride accumulator plant operates the police telegraph system, which we illustrate in the accompanying engraving Fig. 5, and which in size

Fig. 5.—Storage Battery on Police Telegraph System, Philadelphia.

presents a strong contrast to the space occupied by the gravity batteries heretofore employed for the same purpose. We may also mention that the fire alarm systems of Hartford, Conn., and Jersey City, N. J., are also equipped with accumulators.

As we have remarked above, it is probably only a question of time when the gravity battery will be relegated to offices of the most minor importance. The work demanded of the storage battery in telegraph work is so uniform that the life of the cell with ordinary treatment ought to be practically indefinite.

ROUNDABOUT NOTES IN ELECTRICAL EUROPE.—II.

BY

E. J. Wessels

FRANKFORT ON THE MAIN.

The only electric road operating in this opulent and beautiful old city is the Frankfort-Offenbacher-Trambahn-Gesellschaft. The road was opened about 11 years ago and has not been extended, owing to the objections on the part of the municipal authorities to overhead wires.

The cars are small and there are few alike. Each seems to differ from its neighbor in some form or other. Contact is made by two sliding shoes which bear against the wire. The wire itself runs underneath a protector closely resembling a gas pipe.

The rail is light and would not stand the pound and rough wear from heavy cars. The road is single track and has numerous turnouts. Siemens-Halske motors are used, one to a car. There is not much power available and cars move slowly. There are no grades, otherwise the cars would often be stalled. The power station is at Oberrad, several miles from the Capital, and is substantially constructed. As in many stations here, much prominence is given to daylight and ventilation. It is very easy to examine all parts of the machinery without artificial light.

The managing director lives over the bureau alongside the powerhouse, and so is in constant touch with everything.

The car wheels are very light and would not answer for American roads. They are chiefly made with spokes. A wheel with a solid face is a rarity. So long as this road is not permitted to reach the heart of Frankfort, its present rolling stock will suffice; but as soon as traffic is heavy, the cars will need to correspond. The road must be regarded as in a transition state and has good possibilities ahead.

The cars are braked with an ordinary hand brake, which answers all purposes since there is an utter absence of speed and grade, and the cars are not overcrowded. Indeed overcrowding is rare The number of seats for passengers is painted on the car, and the number of "standing places." When this number is aboard a placard is hung out announcing that the car is full and thereafter it does'nt stop until some of the passengers alight. This arrangement is excellent for comfort but doesn't improve dividends. This road pays and declares dividends derived from a 10 pfennig fare (2½c.).

Iron and wood poles are used, and these are attractively painted. At places where cars are stopped, attractive porcelain signs appear, which explain that these are halting places.

On this route one cannot find anything which is an improvement upon American practice. Indeed, if some of the methods employed on suburban roads there were practised on the Frankfort road, it is most likely that the riding public would have helped the company to secure further rights and extensions. There is not much to show for an eleven years' existence. Details of generators, motors, etc., are omitted as the system is too small to warrant special mention.

HANOVER.

This most important city is the seat of vast manufacturing enterprises and has a very large population. It is very beautiful, and cleanliness and thoroughness are everywhere apparent. It has the advantage of standing by itself, and its geographical position is unique. It has no large neighboring cities nearer than Braunschweig.

It being progressive, one is not surprised to find that electric traction has here made considerable headway. As in other German cities, the road does not enter the heart of Hanover, so that the riding public is deprived of all-round rapid transit and must patronize the horse cars still in many streets.

All the lines in Hanover (horse and electric) are under one control. The service is cheap and excellent. The cost of construction of the electric road exceeds that in America, as the paving demanded is "gilt-edged." In fact it seems too good, viewed in the light of dividends.

The Hanover electric road has in active service 32 motor cars and 150 trailers. With the horse car routes we need not concern ourselves as the horse is bound to go shortly. The electric road extends from the outskirts of the city, beyond, and the power house is conveniently situated in case the whole system is converted into electric. The motor cars are not standard but are of different types and come from Holland, Belgium, France and Germany. There is great diversity in the trucks also. Few are alike, and the absence of springs is apparent when one takes a long ride. The trucks are rigid and make sorry work when rounding curves.

Apropos of these narrow gauge roads it may be well to state that even if swiveling trucks were used, matters would not be improved, as the roads are so crooked and many of the streets so narrow, that there would not be sufficient clearance for the car bodies.

The electrical equipment was furnished by Siemens & Halske, Berlin. High speed is unusual but there is no reason why this could not be made. The road bed is in excellent condition. The fare is 10 pfennigs, and last year the road paid 3½ per cent. dividends. Clement Adam is chief engineer, and the managing director is Theodore Krüger. The road has only been running since 1893. It has four divisions and is 13 kilometers long (about 8 miles). It is free from grades and on the small motor cars drawing short trailers braking is done by the motorman who applies his hand brake and depends upon his car for the braking of the trailer. This at best is a hazardous performance and bumping is inevitable.

A curious contrivance which exists in Hanover and elsewhere is the bell for warning pedestrians and drivers of the approach of the car. There is no gong worked by the foot, but instead, above the brake handle and attached thereto, is a bell which has a sliding hammer. The motorman raises and lowers this, which makes the bell ring with a sharp clear note. It is preferable to some of our gongs and might be used to advantage.

The controller is of peculiar shape and by no means as compact or convenient as the well known types in America. It is round, lies flat against the dasher and is more clumsy to operate than the American type. I saw a test of accumulators made on this road. There were four parties checking the readings against each other. It was interesting to observe that they discarded the German amperemeter they started out with and used the Weston instruments entirely.

The poles on the Hanover route are graceful and painted attractively. In a number of places the span wires are held by fancy rosettes which are fastened to the masonry of the buildings. All the cars abound in signs "Nicht spucken" (do not spit) "Nicht rauchen" (do not smoke). They have very wide platforms and look much like the "Accelerator" cars at home but for the location of the doors.

One is impressed with the gentlemanly conduct of the conductors. They usually greet you with "good morning" or "good afternoon" and thank you when you have paid your fare. Something of this sort would produce good results on some of our American roads.

SAVE A LOT OF TIME AND LABOR.

Mr. C. Doutre, electrical engineer for the Richelieu Ontario Navigation Co., Montreal, Can., writes: "The Data Sheets you are at present issuing are very good; they save a lot of time and labor."

THE BELFAST GAS ENGINE-STORAGE BATTERY STATION.[1]

The latest development in gas-engine stations for electric supply is represented by the station recently put into operation by the Corporation of Belfast, Ireland. As long ago as February, 1893, the plans for a system of supply to a limited area were laid before the City Council by Prof. A. B. W. Kennedy, and were accepted; these forming the scheme upon which the present works have been carried out. No doubt, on account of the experimental nature of the trial of gas power, as well as from the fact that it is a simpler matter to duplicate such stations than stations driven by steam power, it was decided to restrict the capacity of the station to 8,500 lamps, allowing that only 6,100 lamps will be alight simultaneously in the ordinary course.

System Adopted.—The system which was decided upon by the Corporation, on the recommendation of Prof. Kennedy, was as follows: Power was to be derived from the Corporation town gas mains, the gaseous fuel being used to drive gas engines; these engines were to be geared by ropes to continuous-current dynamos, which, in conjunction with a large storage battery, were to feed a network of 220-volt three-wire mains, consisting partly of bare copper strip and partly of covered cables, by means of feeders of copper strip and covered cable. Balancing dynamos and a suitable system of battery switching were to be employed for keeping the two 110-volt sections of the three-wire system properly regulated. The scheme included no provision for street lighting; but, as has been said, it made ample allowance for the supply of 6,100 glow lamps simultaneously. The estimated cost of the plant for the generation, storage, and distribution of power for this system of supply was £19,000, exclusive of land, buildings, and consumers' meters.

The general arrangements of the engine and battery rooms, and of the outlying offices, &c., may be learned from Fig. 1, by means of the key which accompanies that illustration. In every way these seem well adapted to the peculiarities of the system and to give efficient service. Fig. 2 is from a photograph of the interior of the engine room looking in the direction of the switchboard.

The present equipment of the engine room comprises altogether six sets of rope geared gas-engines and dynamos. Four of these sets are for the general supply through the feeders, and the remaining two—which are of smaller power—may be used either for this same purpose or for balancing the three-wire sections. The smaller dynamos are provided with special commutator arrangements—which will be described presently—to enable them to fulfill this double duty, being in the former case required to give 220 volts, and in the latter instance only half that pressure. Gas is metered into the station through two large meters, and passes along one large supply pipe, from which branch pipes convey the gas to the several engines. The Corporation makes a charge for gas at the rate of 2s. 3d. per 1,000 cubic ft. The charge to townsfolk for gas is 2s. 9d. per 1,000 cubic ft., with discounts.

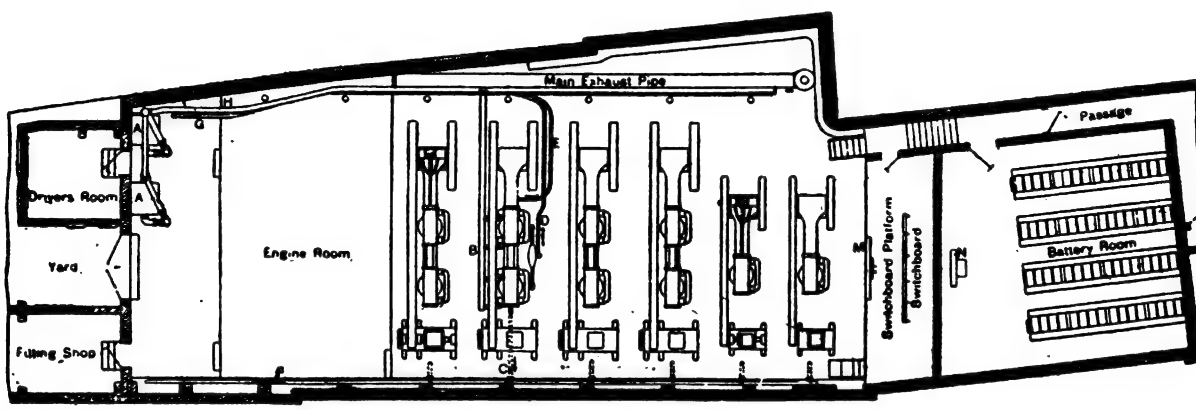
Gas Engines.—As already has been stated, there are six gas engines now installed. These have been constructed to Prof. Kennedy's specifications by Messrs. Dick, Kerr and Co., of Kilmarnock. Four of these engines are capable of developing a maximum of 120 I. H. P., and are used for driving four Siemens 60-kilowatt dynamos. The remaining two engines are coupled to Siemens 26.5-kilowatt dynamos. The contractors have guaranteed that the consumption of Belfast gas by these engines, when at their rated load, shall not exceed 26 cubic ft. per electrical horse-power per hour, as measured at the dynamo terminals. By a six-hours' trial at the contractors' works, it was found that the consumption of Kilmarnock gas did not exceed 24 cubic ft. per electrical horse-power hour, under the specified conditions. The combined $\frac{\text{E.H.P.}}{\text{I.H.P.}}$ efficiency of the engines proved to be about 76 per cent.

The engines have each two cylinders, both double-acting and are thus capable of giving an impulse at each stroke. The two pistons are arranged on the same rod; there is only one crank, the cylinders are placed in tandem, and the width of the engine is no more than that of a single-cylinder engine of half the power. In order that this arrangement might not spoil by increased length the economy of space which resulted from decreased breadth, the method of backward driving was adopted, the cylinders being located between the flywheel and the dynamo alongside of the rope-drive. Thus the amount of floor space covered by the plant is actually less than would be required by a forward-driving single-cylinder engine of equal power. Again, in order that backward driving should not put the ropes into slack tension at the bottom and tight tension at the top—a plan which would cause the ropes to lift off the pulley grooves except over a small arc, thus making the ropes slip—it became necessary to design the engine so that it would turn the flywheel in the reverse to the usual direction. That this method results in getting a compact engine room, a glance at the engraving (Fig. 2) will suffice to show. A scale drawing of one of the larger of the Belfast engines is shown in Fig. 3.

The cycle of operations which is carried on at each end of both cylinders is the well known Otto cycle. The phase relations of the four cycles are adjusted so that, at full load, there is a quick succession of impulses; no two impulses in any one engine occurring at the same time. The explosions occur in the following order: first, there is an explosion in the back end of the back cylinder, then one in the front end of the front cylinder, then one in the back end of the front cylinder. Thus, by the distribution of the load among four suitably arranged Otto cycles, it is probable that the tendency to fluctuation is reduced to one-sixteenth of the tendency in a single-acting single-cylinder engine of equal horse-power and flywheel inertia.

The engines are designed to run at constant speed—160 revolutions per minute—at all loads, accurate speeding-up being as yet practically impossible in gas engines. At full load there will therefore be 320 impulses per minute. It was originally intended to arrange that at reduced loads the engines would systematically miss one or more of their 4-cycle explosions. This arrangement, however, has not been finally adopted, it being found to be preferable to arrange that the whole of the regulation by the governor shall be effected by varying the proportion of gas used in all four explosions. The four large gas engines are each provided with 8 ft. 5 in. cast-iron grooved pulleys, which drive the large dynamos by means of eight 1-in. ropes on each pulley. In addition to the grooved pulley each crank shaft carries a heavy cast-iron flywheel for giving greater steadiness in running.

One of the problems in connection with a gas-engine station is, how to arrange to economically and quickly start the engines as they are required. The practice of pumping or otherwise admitting an explosive mixture into the motionless and inert engine, and then firing the machinery into activity by one sudden blast is used in some places, but it puts a heavy strain on the parts which are thus suddenly set in rapid motion, and it is not one which an



A = Gas Meters (two).
B = Exhaust Pipe from Engines.
C = Water Pipe from Engine to pipe F.
D = Gas Pipe to Engine.
E = Water Pipe from Cooling Tank to Pump.
F = Water Pipe from Engines to Cooling Tank.
G = Water Pipe from Tank to Engines.
H = Main Gas Pipe.
K = Exhaust Silencer.
L = Resistance Frames.
M = Shunt Resistance Switches.
N = Battery Regulators.
O = Water from Cooling Tank.
P = Gas Main (same as H).

FIG. 1.—ENGINE AND BATTERY ROOM, BELFAST STATION.—PLAN VIEW.

1. Abstract from the London *Electrician*.

engineer could ever bring himself to admire. At Belfast the simple expedient of running the dynamos as motors off the station batteries, or other engines when any are running, is resorted to, the dynamos thereby running the engines until the proper charge

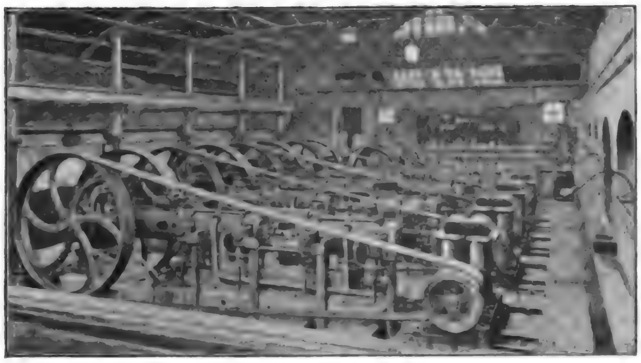


Fig. 2.—Engine and Dynamo Room, Belfast Central Station.

has been drawn into the cylinders and compressed, when it explodes and the engine runs up to the speed controlled by the governor. The amount of current sent through the dynamo when starting-up is regulated by a hand rheostat, the hand gear for which is situated by the switch platform rail, overlooking the engine room, and the resistance frames are placed beneath that platform.

Dynamos.—The six dynamos for this station were supplied by Messrs. Siemens Bros. & Co. The four larger machines are rated at 60 kilowatts, but are normally only intended to develop about 57½ kilowatts. They are two-pole, drum-wound, shunt machines, and are designed to run at 600 revolutions per minute. Under normal working the field is regulated to give from 225 to 240 volts at this speed, but the machines can be made to develop as high as 250 volts for exceptional work.

The two smaller machines call for more detailed consideration, on account of the diversity of the work for which they are designed. These machines are both of the two-pole shunt-wound type, and each is designed to develop about 26½ kilowatts, running at 750 revolutions per minute. The armature of each of these dynamos is double-wound, each of the windings being connected to an independent commutator. Each winding develops from 110 to 120 volts, at normal speed and excitation; and there are switchboard arrangements for putting these two windings in series or in parallel. When they are in series the voltage of the machine is, of course, normally between 220 and 240 volts; but on occasion, with this arrangement, a voltage of 270 volts is developed. These machines, when run with the armature winding of each in

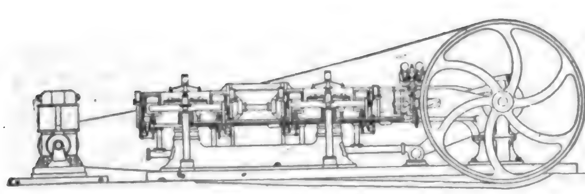


Fig. 3.—Gas Engine and Dynamo.—Side Elevation.

parallel, are intended for use as balancing machines on the three-wire network.

Electric Storage Plant.—At the Belfast station there are two large storage batteries, one for each of the two sections of the three-wire network. The arrangement of these batteries in their special room is shown in Fig. 4, which gives a perspective view of a battery room about 28 ft. square. Each battery consists of 63 E. P. S. cells of the 34-K type, in lead vessels. Besides these, there is a reserve of eight "hospital" cells, or "milkers."

Battery Regulation.—The unique system of battery regulation which is in vogue at the Belfast station, has been designed by Prof. Kennedy and one of his assistants, Mr. B. M. Jenkin. The usual plan of entirely cutting the end cells out of circuit, on the positive or negative battery, when the pressure on one side of the system is to be lowered, has here been abandoned, every cell being retained in the circuit, whatever the pressure required on the feeders. In order to regulate the pressure applied to the feeders, the end cells of the batteries, which are most remote from those connected to the bus bars on the switchboard, are put in parallel with one another—the last few cells of the two batteries being, as it were, electrically telescoped; and the number of cells on each battery thus placed in parallel with the similar cells on the other battery is made to vary with the total pressure required between the positive and negative feeders. In addition, the point of connection of the middle wire will be shifted either towards the positive or towards the negative end—this middle wire making, of course, a contact at some point on the telescoped cells on each of the batteries—according as it is desired to give either side a greater or lesser pressure.

This ingenious method of getting over the need for removing cells from the circuit in order to regulate the pressure is more clearly explained by reference to Figs. 5 and 6. In Fig. 5 it is supposed that the pressure of only 106 cells is required between the positive and negative feeders, and that an equal number of cells is required on the two sections. Now, there are in all 126 cells in the two batteries; so that 20 have to be put in parallel with another 20. In order to do this the cells are coupled as shown in the figure; and in order that there may be the pressure of 53 cells on each section, the middle wire must make contact with the 53rd cell of *each* battery. Now, turning to Fig. 6, we suppose that it has been necessary to alter the balance given by Fig. 5, and that we now require the pressure of 54 cells on the positive section, and only that of 53 cells on the negative section. To obtain this, 19 cells will now be "telescoped"—instead of 20, as before—and the middle-wire contact will be with the 54th cell of the positive battery and with the 53rd cell of the negative battery,

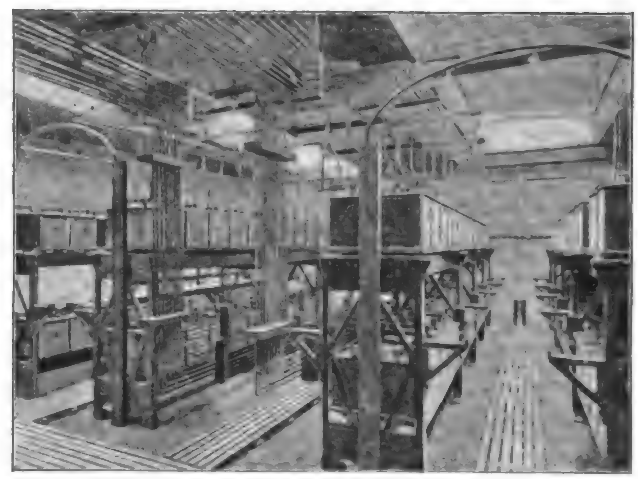
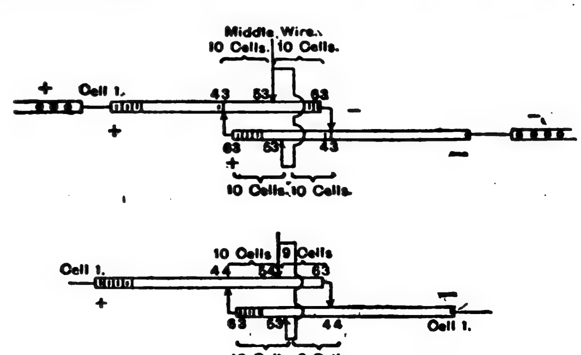


Fig. 4.—The Battery Room, Belfast Central Station.

these two cells being at the same potential. In the same way adjustments can be made to give any desired pressure on either section, and it is only necessary to provide that both the middle-wire contacts shall always be with cells at the same potential. This is provided for by a reliable interlocking switch gear, by which it is impossible to short-circuit sections of the batteries or to interrupt the circuits.

This switch is shown diagramatically in Fig. 7. The contacts connected to the cells in each battery on which the regulation is done, are shown lying parallel to each other. Two brushes held by a connecting cross arm connect these contacts to their respective bus bars lying beside them, these bus bars being connected to the end cell (63) of the opposite battery. As this cross arm is moved down it "telescopes" more cells, and if moved up, fewer. By giving one of these brushes a small lead it will make contact



Figs. 5 and 6.

before the other breaks, and in this way the use of pilot brushes is avoided.

The "middle" wire of the system is connected to two bus bars lying outside the contacts by two brushes to these same contacts.

One of the middle wire brushes travels with the centre paralleling switch, while the other remains stationary.

Referring to Figs. 5 and 6, the paralleling switch moves from cell 48 to 44 in each battery, and the middle wire brush on the positive battery moves with it from cell 53 to 54. But the middle wire brush on the negative battery remains stationary on cell 53.

The paralleling brush is worked by a wheel on the front of the switchboard working a pinion geared into a rack.

The whole of the battery can be charged or discharged in parallel with the dynamos, the telescoped cells working at half the rate of the main battery. The telescoped cells can also be charged by themselves by altering the connections at the link switches on the small machines. This arrangement is shown in Fig. 8. Dynamo No. 1, or C, is now between the positive bus bar and the negative *end* of the positive battery; not between the bus bar and the middle-wire contact, as in Fig. 9. Similarly, dynamo No. 2, or D, is between the negative bus bar and the positive *end* of the negative battery. Current is going from the positive of C, by the positive feeders to the mains and lamps, back along the negative feeders to the negative of D, from the positive of D, through the link switch to the positive *end* of the negative battery, where the current splits between the cells in parallel, charging them, then from the negative *end* of the positive battery, through the link switch to the negative of C.

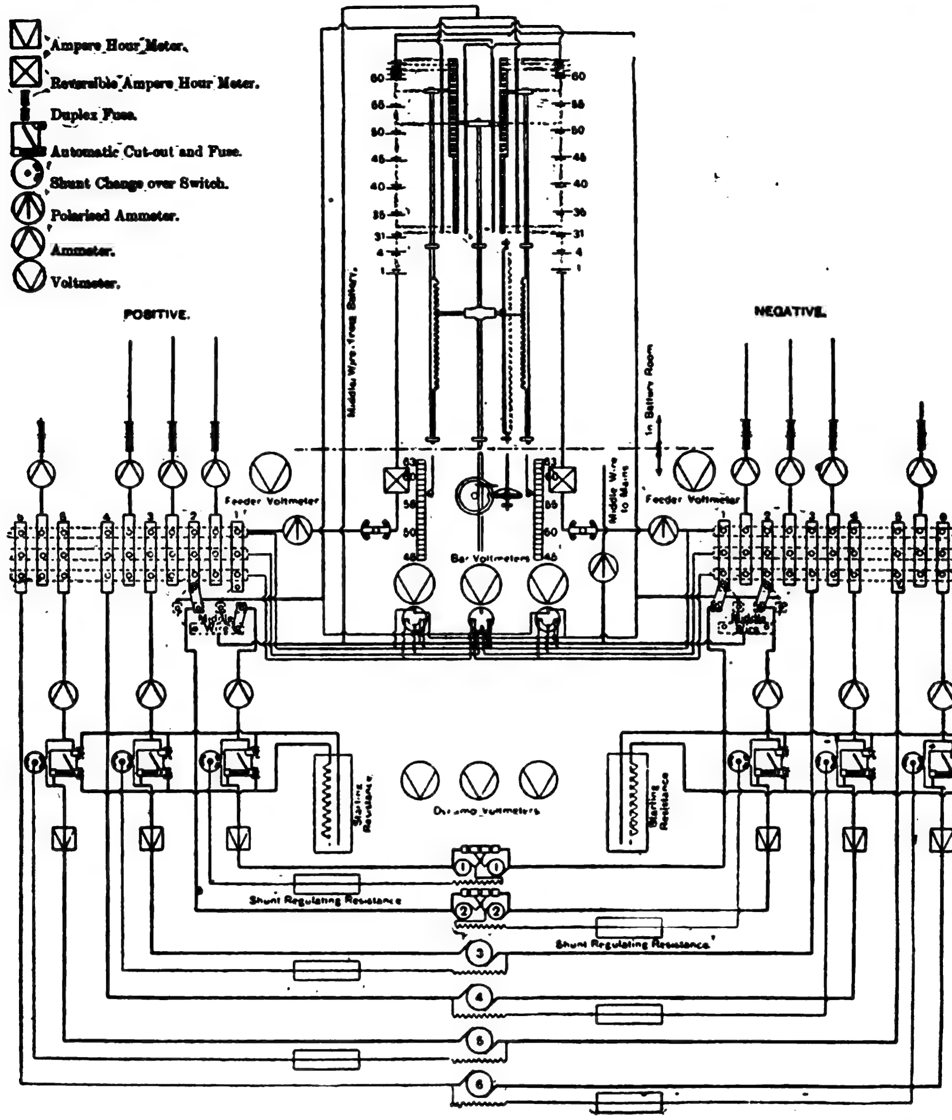


FIG. 7.—DIAGRAM OF SWITCHBOARD CONNECTIONS, BELFAST STATION.

The two balancing machines, C and D, can thus be run at full load on circuit and charge the centre cells at the same time.

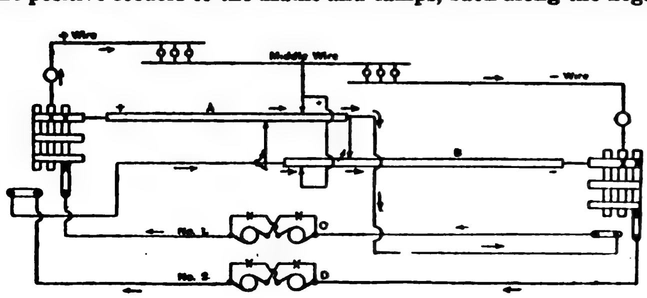


FIG. 8.

As the load on circuit falls the current can be sent into the main part of the battery charging it, and so keeping the dynamos at full load, until the load on circuit has dropped to half that of the small machines, when 100 amperes would be going out on circuit, and 100 into the main battery. As the current on circuit splits equally between the centre cells we have 50 amperes due to it, and also 50 each side due to the 100 amperes charging the main battery; we thus have every cell in the battery charged at 100 amperes.

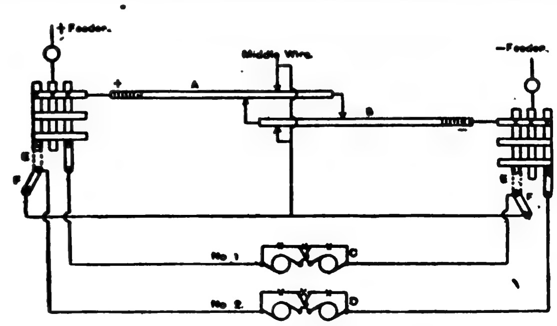


FIG. 9.

This arrangement is only occasionally used when the centre cells want more charge than they get in the ordinary way.

Mains.—The feeding and distributing mains are chiefly of bare

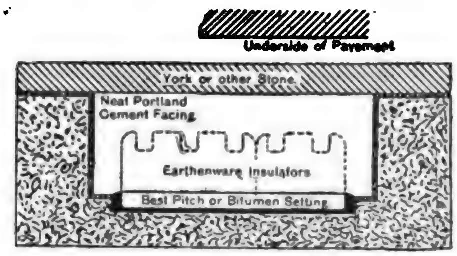


Fig. 10.

copper strip, arranged in concrete conduits and supported on porcelain insulators; but where the mains cross streets, or in some of the narrow streets, or again, in some places where the boggy nature of the soil makes bare copper distribution difficult and risky, covered cables have been laid down. These cables were made by the Callender Bitumen Company. A transverse section of the bare copper strip conduits is shown in Fig. 10. The arrangements of the porcelain insulators for carrying either the three wires, or the three wires and a pair of feeders, will be clearly seen in this drawing. Belfast lies very largely upon a swampy or boggy soil, and this fact has had to be taken account of in the design of the conduits and street boxes, as well as in the arrangement for inspection. There is a small screw plug in each of the street box covers, and each man who goes the round of inspection carries with him a small portable pump and a gauge stick. With the latter instrument, which he inserts into the box after unscrewing the plug, he can gauge the accumulation of water in the box; and with the hand pump he can clear it out.

The whole of the work has been carried out under the superintendence of Prof. Kennedy and his chief assistant, Mr. Burstall; Mr. Victor A. H. McCowan, who was appointed electrical engineer to the Corporation in April, 1894, acting as resident engineer.

ELECTRIC TRANSPORTATION DEPARTMENT.

OPENING OF THE BURLINGTON & MT. HOLLY ELECTRIC BRANCH OF THE PENNSYLVANIA R.R.

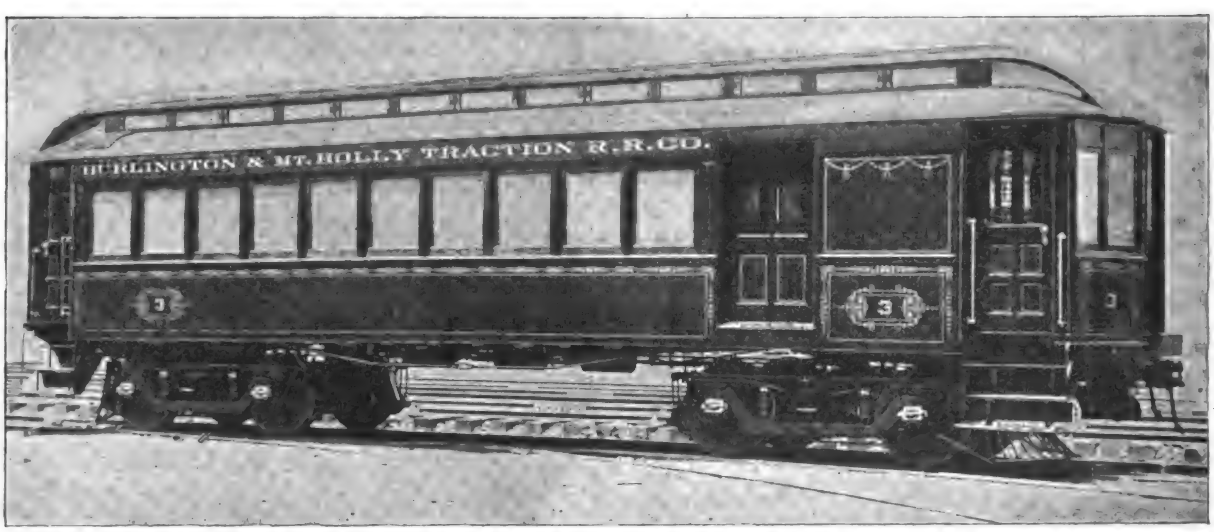
On Monday July 22 the Burlington & Mt. Holly (N. J.) Branch of the Pennsylvania R.R. went into regular operation as an electric railway. The distance between these two towns is 8 miles. The fare is 10 cents each way and 10 trains are run each way on week days and 9 on Sundays.

Span wire construction is used throughout. The poles are of chestnut and are all planted 6 ft. 6 in. below the top of the lowest surrounding ground. The top of every pole is exactly 25 ft. from the top of the rail and on the poles which are used to carry feeders, the cross arms are placed 24 ft. from top of rail. The trolley wire is 22 ft. above the level of the rail.

The feeders are two in number, being each 500,000 c. m. One runs the full length of the road and the other three-fourths of the way. These cables were strung by a construction train composed of a flat car, a pile driver and the locomotive. The span

The motor cars are slightly smaller than the standard Pennsylvania Railroad coach, and have the following dimensions: length of body in frame, thirty-five feet; length over platform, forty-three feet six inches; width of car at sills, nine feet four inches. The cars were built by the Jackson & Sharp Company and have closed vestibule ends with side doors. The interior finish is of Mexican mahogany, light in color, and the side and top ceilings are of handsomely figured white birch veneer, highly polished, but without a line of decoration.

As it is the purpose of the railroad company to haul regular passenger coaches as trailers, the motor cars are equipped with the company's standard Jenney platforms, couplers and buffers and have an end entrance for passage from one car to the other. The seats are of the Bushnell type, with reversible fixtures and tilting cushions. They are upholstered in crimson plush, but are not fitted with the usual side arm. This is quite a novel feature, and one which it is thought will prove attractive to the traveling public, as it affords more comfort and gives more room.



Combination Passenger and Baggage Motor Car, Mt. Holly & Burlington R. R.

wire for supporting the trolley, is ⅜-inch galvanized standard cable, fastened to ⅝-inch drop forged eye bolts. The trolley wire is No. 00 hard drawn copper and was stretched by another construction train composed of a tower car and engine. The track is the same as the steam road with the exception that the joints are bonded on the outside of the rail and a supplementary wire is run along on each side, there being two supplementary wires.

The power plant is located at the Mount Holly terminus and consists of a Westinghouse direct coupled generator and compound engine, and a Climax boiler of 300 H. P. capacity. There are three motor cars of sufficient power to draw standard Pennsylvania Railroad coaches for trailers and maintain a speed of from forty-five to sixty miles an hour.

The lighting is by electricity with lamps along each side of the roof. There are also auxiliary fixtures in the center for burning oil if the current should give out. The cars will be equipped with twenty-two Central Electric heaters, one under each seat in the passenger compartment and two in the baggage compartment.

The trucks are of the Jackson & Sharp Company's standard type, made to conform to the Pennsylvania Railroad standard requirements as to pedestals, boxes, journal brasses, etc. The wheels are thirty-six inches in diameter, and a part of them were furnished by the Allen Paper Wheel Company, and a part by the Standard Car Wheel Company. The axles, motor supports and other parts are designed to carry Westinghouse seventy-five H. P. motors, two to each car, although the

first car was equipped with four fifty H. P. motors. Attached to the front part of each truck there is a light iron fender, made on the same principle as the ordinary locomotive cow-catcher. This is only intended as a protection for safety and to prevent a derailment of the train, and is intended to remove all obstacles from the track.

The baggage compartment in these cars is finished in the usual manner, so that baggage, express and marketing can be conveniently handled. There are also in this compartment, however, side seats with a hinged section to cover the space of the side doors. These seats are designed for the use of smokers, so that the car may practically be termed a combination smoking, baggage and passenger car.

The cars are equipped with Westinghouse air-brakes supplied with air pressure by a special compressor operated by a small electric motor. This motor is arranged to be cut out of service when the normal pressure has been reached in the reservoirs.

THE BOILER HOUSE OF THE BALTIMORE TUNNEL PLANT OF THE BALTIMORE & OHIO R. R.

In our issue of July 10, we gave an illustrated description of the main features of the electric locomotives and power plant of the Baltimore & Ohio R. R. tunnel at Baltimore, a piece of engineering that is deservedly attracting attention from engineers and railway men the world over.

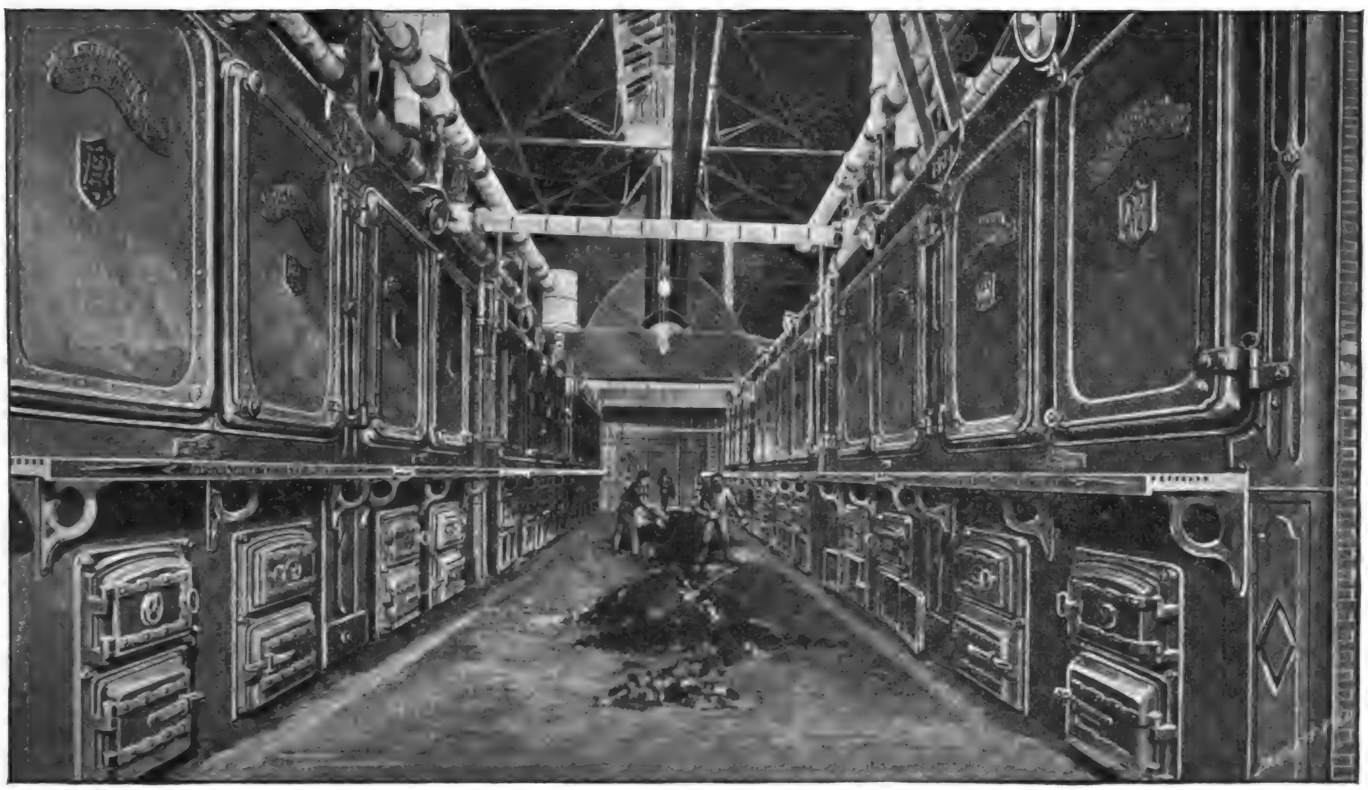
The comprehensive nature of that article made it impossible to dwell in detail on some of the most interesting features of the power plant, among these being the boiler house, but we are now enabled to give a more complete account of this important part of the equipment, which is illustrated in the accompanying engraving. Standing in the foreground the visitor finds himself looking down a fire room some seventeen feet in width and about ninety-four feet in length. On either side improved Root water tube boilers are placed, there being eleven in all, having a total rating of 2,750 horse power. These boilers are arranged in batteries of two boilers each, the odd boiler standing as a half battery. Between each battery a space of thirty inches is found which allows of inspection and cleaning of the exterior of the tubes through the cleaning doors which are placed in the side walls of the boiler. At the further end of the room a space of 21 feet is left between the boilers and end wall, and in this space are found the pumps and heaters of the plant.

On account of the limited space available, it was found impossible to provide a space of over 28 inches between the rear boiler walls and the side walls of the building in which to place the flues connecting the boilers to the chimney, so the main flue was run along the top of the boilers, at their rear, and was made to overlap the 28 inch space. By this arrangement the individual flues from each boiler, after leaving the flue opening in the rear boiler wall, rise to the bottom of the main flue where they enter.

The main flue is made of wrought iron, is rectangular in shape and tapering. At the smallest end it is two feet wide by four feet high, and at its larger end it is six feet wide by seven feet high. It will be understood that there is one main flue of the above description running along at the rear of each row of boilers, one at the right and one at the left. These two main flues finally meet at the further end of the room and join into one common smoke box, also rectangular and made of wrought iron.

The smoke box is clearly shown in the cut, and behind it can be seen the outlets of two pressure fans, which are continually exhausting the gases, etc., from the large smoke box, and they finally discharge these gases into the vertical stack which is plainly seen in the centre, rising through the roof. Thus the gases are handled by what is termed an "induced draught."

The steam piping commands the attention of the engineer the moment he steps into the boiler room. Its graceful and easy curves allow for all expansion and contraction which may take place along the line of pipes. A system of duplicate steam mains with the proper connections makes it possible to throw out of service, in a very short interval, either one of the two steam mains and to change the work entirely to the other; and it is also possible to cut out or throw in any one, or any number of the boilers without interfering with the continuous operation of the plant.



Battery of Root Boilers in The Baltimore Tunnel Electric Power House.

The steam mains run through the boiler room over the top of the boilers, collecting their supply of steam from each boiler as they pass it. At the further end of the room, these steam mains drop below the level of the floor, into a large trench, along which they run to the opposite end of the engine room with risers running up to each engine they pass.

Many do not understand that this is a central lighting plant as well as a central power station, supplying the necessary current to take the trains over the Belt Line through the tunnel and besides this service three of the boilers are designed to take care of the lighting of the many incandescent lights to be placed throughout the tunnel, and also to further furnish current for the numerous arc lights distributed through the local yards of the Baltimore and Ohio Railroad Co.

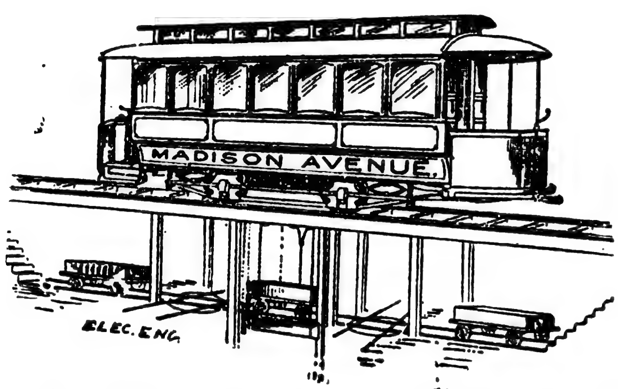
As this was the first railroad to adopt electric locomotives, the greatest care was exercised by the General Electric Co. to make it, in every way, a success, and nothing was contracted for that had not been thoroughly tested by them and found equal to every demand that could be made upon it in this plant. With a view to the selection of the boilers, the Root boilers in their Lynn Thomson-Houston factory plant were subjected to

very severe tests and were found equal to every demand made upon them. These tests led to their adoption for the Baltimore & Ohio Railroad and also for the new plant they afterwards erected in Lynn known as the "River Plant."

STORAGE BATTERY CARS ON MADISON AVE., NEW YORK.

It is now nearly six years that an attempt was made to operate the Madison Ave. street cars in New York by means of storage battery traction, and although ten cars were equipped in all, the results attained did not appear to warrant the adoption of the system. Since that time considerable progress has been made in storage battery traction and the continued successful operation of three lines in Paris equipped with storage cars, in one case extending over two years, has demonstrated that this mode of traction is now commercially practicable. Much of the success attained in Paris is no doubt due to the improved type of cell employed, the Chloride accumulator being used on all the lines, and the cars on the Madison Ave. line will also be equipped with this type of cell, manufactured by the Electric Storage Battery Co.

These cars, which are now in course of construction, will be of the standard type of electric car, 18-foot body and about 23 feet over all. They will be mounted on Peckham trucks, carrying General Electric motors. The cars will have many improvements over the old type of electric car. For example, the batteries will not be carried in the car body, as has been hitherto the practice, but will be suspended from the truck under the centre of the car, as shown in the accompanying engraving. The tray or box containing the batteries is readily and quickly detachable from the truck and removed, for the purpose of charging, on a



Charging Arrangement for Storage Cars, Madison Avenue Line, New York.

small transfer car running on rails to and from an elevator situated between the street car tracks and running beneath the floor to a cellar or subway, the elevator being adapted to hoist the batteries into place on the car truck, or to remove them therefrom, as the case may be. By this novel arrangement a car can be loaded and unloaded in about half a minute. It will be seen that with this new system of carrying the batteries on the truck any car body is adapted for use in this service, thereby saving a company adopting the system considerable expense by enabling it to use its present car bodies.

ELECTRICITY ON THE ERIE CANAL.

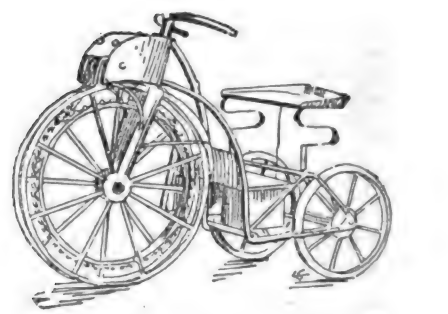
Mr. Frank W. Hawley, representing the Cataract General Electric Company, has applied to the New York State Superintendent of Public Works for permission to experiment with a new system for towing boats on the canals by electricity. The test will be made Sept. 25, on the Erie Canal, for a distance of four miles between Buffalo and Tonawanda. The Cooper & Hewitt cable traction system will be used and operated from the canal bank. The electricity will be furnished by the Niagara Power Company. The experiment will be made on a four-mile section of the canal upon which are overhead bridges and sharp curves, in order that the system may be fully tested.

SUTRO POWER HOUSE, SAN FRANCISCO.

The Sutro Electric Railroad is rapidly nearing completion, and by the middle of October at the latest, and probably sooner, the line may be expected to be in operation. The plans for the power house, which will adjoin the baths, will include a promenade on the roof, which will be of iron and glass. From the roof a view of the ocean can be obtained, and the machinery in motion also can be seen. The building will be one story in height. Contracts for the engines, dynamos and generators have been let to the Fulton Iron Works of San Francisco.

THE BARROWS ELECTRIC TRICYCLE.

The accompanying engraving represents a model of an electric tricycle design, by Mr. Charles H. Barrows of Willimantic, Conn. The forward wheel is the driver and is constructed with two rubber-tired rims, between which is what corresponds with the sprocket in the bicycle. The electric motor is carried in a box



The Barrows Electric Tricycle.

over the driver and is connected with the driver by a sprocket chain. The storage battery is placed between the two rear wheels.

A seat capable of carrying from one to three persons is over the smaller rubber or pneumatic tire wheels. The guiding device is similar to that of the ordinary bicycle.

PROPORTION OF DEATHS BY TROLLEY ACCIDENT.

When it comes to a comparison of our trolley traffic, says the *Brooklyn Eagle*, with the death rate on the great steam roads, the proportion is astonishingly in favor of the much denounced Brooklyn trolleys. This is the more notable as the steam roads have their tracks guarded from the intrusion of pedestrians to a great extent. They have raised crossings at the more dangerous points along their lines and the precautions for the protection of life by the block signal system and otherwise are elaborate and ingenious. Yet the New York Central railroad reports one death for every 69,000 passengers which it carried; the Delaware, Lackawanna and Western one death to every 67,000 passengers; the New York, Lake Erie and Western one death to every 110,000 passengers. If the Brooklyn trolleys or any other trolleys made a death rate like that, there would be riot in the city until the cars were removed from the streets. (In Brooklyn the proportion is only 1 in every 8,135,000 persons carried.—Eds. E. E.) No one hears anything about the Central juggernaut or the Erie juggernaut. This is not a plea for reckless trolley running, nor for an increase in the Brooklyn death rate by means of accidents, but there is good traditional authority for giving the prince of darkness his due, and when the railroad officials are able to show that their death rate is lower than that in other cities and far lower than that of steam roads running through large thinly settled districts the facts ought to be considered before unlimited denunciation is dealt out to them. The trolleys were placed on our streets by the consent of the city. Even their most virulent critics do not want to return to the horse cars. When the officers of the lines are making vigilant efforts to reduce the number of accidents they are entitled to fair play in public discussion.

GOOD BRAKES NEEDED FOR STREET CARS.

Referring to our advocacy of air brakes for street cars the Syracuse *Courier* remarks: An electrical paper, in discussing the question of fenders as life preservers for electric cars, suggests that good brakes are more of a necessity to street cars than the fenders, concerning which so much is being said about the country. Very likely this conclusion is correct. Inventors are reported to have already devised power brakes by which the motorman, by a slight movement of the hand, can almost instantaneously stop a car, while running even at a very high rate of speed. These brakes are quite expensive and for this reason, possibly, they have not been, as a rule, adopted by the trolley companies. The time will come, however, when the railroad companies will be compelled, both by public opinion and by business considerations, to adopt every or any practical appliance, no matter how expensive it may be, which will protect human life. Costly litigation will follow the killing of people on the public streets, and in time, if the killing continues, the damages that in many instances must necessarily be paid will far exceed the cost of appliances which would prevent such accidents. The objection is raised by the trolley companies to the use of the instantaneous brake, that the immediate stopping of the car would shake up the passengers and possibly bruise some of them. This argument is not a tenable one, for steam

cars running at the rate of forty or fifty miles an hour, are often stopped by the application of air brakes and the reversing of the engine to prevent accidents, even if the passengers are somewhat shaken up by the operation. It would be better for the trolleys to slightly bruise a few people than to kill one by their inability to stop in time to prevent such killing. In the long run the most expensive appliances for the trolley cars may become the cheapest.

THE USE OF ELECTRIC POWER BY THE CHICAGO & NORTHERN PACIFIC AND THE "C. B. & Q."

Suburban residents along the lines of the Chicago and Northern Pacific and the Chicago, Burlington and Quincy railroads will soon be able to ride to and from the city on swift-running electric trains. The Northern Pacific is about to substitute electricity for steam on its line, as already announced and a new corporation is planning an extensive system of trolley lines along the Burlington to reach the towns of La Grange, Grossdale, Austin, Ridgeland, Oak Park and Lyons. The Town Board of Cicero has granted franchises for both enterprises, and their backers assert they will be pushed to an early completion.

The improvement proposed by the Northern Pacific contemplates the use of electric power instead of steam over its entire system, and is regarded by railroad men as one of the most important departures for years. This road will, in fact, be the first in the West to use electricity for its motive power. It is expected that the steam locomotives will be abandoned within four months. General Manager Samuel P. Ainslie says: "I do not wish to discuss the matter just now. I will say, however, that it is true we were granted an ordinance by the township of Cicero to operate our trains under a new system. We expect to equip our entire service with the new power."

The franchise granted by the trustees of Cicero, at an adjourned meeting, permits the Northern Pacific to run its trains through that town by electric power, which indicates the change which Mr. Ainslie admits is to be made. More than that, the Northern Pacific has already the basis for a mammoth electric power plant in its station at Harrison street and Fifth avenue. When that structure was erected it was planned with a view to ultimately using electricity for motive power in the place of steam. Not only were the foundations put in for a possible power house in the future, but many other features were embodied in its construction to make the conversion of a part of it into a power house a matter of few and quick changes. The plan to replace steam locomotives with electric power can, therefore, be thus carried out with a great saving of time and expense.

The trolley system along the Burlington line is to be constructed by a new corporation, known as the Suburban Electric Company. It has already filed a bond of $20,000 as a guarantee that it would carry out the project on which it secured the right of way from the town of Cicero.

The franchise requires that the new system shall be completed within two years and put in operation, the penalty being a forfeiture of the grant. Its backers declare they have already secured the assent of a majority of the property owners along the right of way. They are confident there will be no opposition, and anticipate no serious difficulty in carrying the project to completion within the specified time.

HEATING CARS BY ELECTRICITY IN MASSACHUSETTS.

The Massachusetts railroad commissioners have sent out the following interesting and important decision in the matter of the heating of street railway cars:

Under the provisions of chapter 136 of the acts of 1895, entitled "An act relative to the heating of street railway cars," after notice to the several street railway companies and a public hearing of such as desired to be heard, and upon consideration by the board, it is determined and

Ordered, That the following requirements and regulations be prescribed and notified to the several companies relative to the subject matter of the aforesaid act:

Regulations for the heating of street railway cars:

1. The several street railway companies shall equip such electric box cars as are used by them for the transportation of passengers in the months of November, December, January, February or March in each year with suitable apparatus for heating the same by electricity; provided, that other than electric heaters may continue to be used in such cars as are now equipped therewith, until the further order of the board.

2. Electric box cars, while in use for the purpose and during the months aforesaid, shall, whenever the outside temperature is less than 50° above zero (Fahrenheit), be kept warmed by such electric or other heaters to an inside temperature (as near as may be) of not less than 50° nor more than 60° above zero, except at times when the company is temporarily prevented from so doing by storms, accident or other controlling emergency.

3. These regulations shall take effect on the 1st day of November, 1895, and may be modified from time to time in general or in particular as experience and the public comfort may seem to the board to require.

WESTINGHOUSE COMPANY AND BALDWIN LOCOMOTIVE WORKS COMBINE FORCES.

On Aug. 5 the important announcement was made that a working arrangement had been effected between the Westinghouse Company and the Baldwin Locomotive Works of Philadelphia. The arrangement is not of the nature of a combination of capital, but solely one of interests.

Commenting on the new departure in an interview a member of the firm of Burnham, Williams & Co., proprietors of the Baldwin Locomotive Works, said: "We have long been thinking that the Baldwin Locomotive Works should take a prominent position in the manufacture of electrical engines, but we found the electrical field so well covered by patents that an outsider must work under great disadvantage. The negotiations between the two companies to overcome this difficulty have been going on for more than two months, and we are now ready to join and undertake any contracts for locomotives run by electrical power."

No immediate extension of the Baldwin plant is contemplated as a result of the deal. The Baldwin works have already experimented in the construction of electrical engines. One was built recently for Henry Villard of the North American Company, to the designs of Messrs. Sprague, Duncan and Hutchinson, and a number of small trucks have been built for elevated railroad use.

It is announced that Mr. David Leonard Barnes, of Chicago, will act as joint superintendent of the companies to overlook the construction of the locomotives. The Baldwin Locomotive Works will confine itself to the building of the rolling stock while the Westinghouse Co. will furnish all the electrical equipment.

CHANGE IN COURSE OF THE CHICAGO HORSELESS VEHICLE RACE.

The course of the horseless vehicle race which will take place on Saturday, November 2, 1895, has been changed, and instead of starting in Milwaukee and terminating in Chicago as at first arranged it will start and end in the latter city. The starting place will be from a point in the southern suburbs which has not as yet been decided upon, and the course will be from Chicago to Waukeegan and back, the length of the run being 100 miles, of which 75 miles will be over perfect roads. On the outward part of the race, it is intended to keep a little inland until Waukeegan is reached, and on the return the road near the lake will be taken and the contestants will pass through Highland Park and Evanston.

It was considered advisable to change the course originally decided upon as a great many Chicago people who would like to see the start and finish of the race would not be able to do so if it were to start from Milwaukee. As the race takes place at a season of the year that is usually very wet, it was thought the roads at the Milwaukee end would possibly be in such condition as to prevent the carriages having a fair trial.

TROLLEY INVADING PENNSYLVANIA MAIN LINE TERRITORY.

The busy trolley has invaded another suburban field hitherto dependent entirely on steam railroad transportation. The extension of the Hestonville system to Overbrook, a suburb of Philadelphia, has been put in operation, and that suburb will henceforth enjoy the advantages of trolley connections with the centre of the city. Cars will be run on a five-minute headway, and a five cent fare will be good for a ride over the entire length of the line. The cars follow the present route of the Hestonville system until Fifty-second street is reached, where they branch off on Lansdowne avenue. Double tracks have been laid on this thoroughfare, and the roadbed is being substantially macadamized. Since the opening of the Haddington line, a short time ago, a remarkable impetus has been given to building operations on Lansdowne avenue. Rows of handsome houses are in course of erection, and many more have been contracted for. Permits were lately issued for the erection of 1200 new houses facing the avenue, bringing the total number projected since the advent of the trolley in Haddington to over 2,000.

Another branch of the Hestonville system will eventually be extended out to Overbrook, by way of Lancaster avenue from Fifty-second street. It is now in process of construction as far as Fifty-sixth street, with double tracks.

TROLLEY RIGHT OF WAY IN NEW YORK STATE.

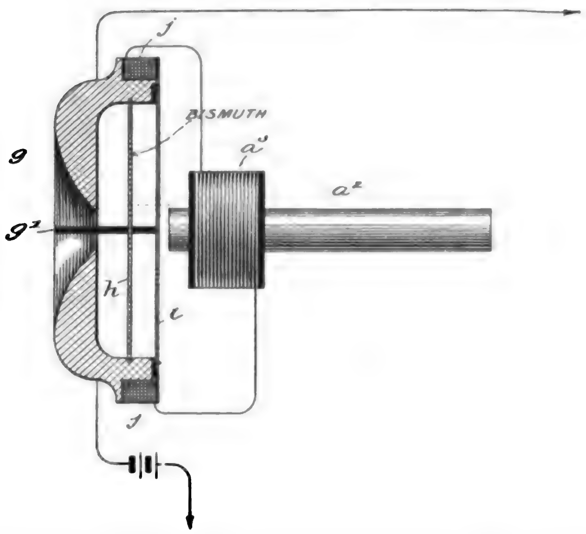
Electric railway companies in New York State will not be slow to take advantage of the law, which has recently become such by the signature of the Governor, which gives to electric railway companies the same rights under condemnation proceedings as are enjoyed by steam railroad companies.

TELEPHONY.

BIGGAR'S BISMUTH MAGNETO TELEPHONE TRANSMITTER.

It is well known that the electrical resistance of bismuth varies when this metal is subjected to the influence of a magnetic field, and the extent of the variation is, within limits, proportional to the strength of the field. This principle is employed in an instrument designed to determine the strength of magnetic fields, by measuring the resistance of a bismuth wire inserted therein.

The same idea has been embodied, though for a different purpose, in a telephone transmitter due to Mr. J. S. Biggar, of San Francisco, Cal. The instrument which is illustrated in the accompanying engraving has a mouth-piece *g* divided into two parts, separated by insulating material g^1. There are two diaphragms, one *h* of bismuth and the other *i* of soft iron and of the usual construction, the latter insulated from the mouth piece. Between the two diaphragms is an air-chamber which conducts the vibrations of one diaphragm to the other. Back of the iron diaphragm is placed the usual permanent magnet and coil. A coil of wire *j* is wound upon the mouthpiece of the instrument



BIGGAR'S BISMUTH MAGNETO TELEPHONE TRANSMITTER.

and surrounds the bismuth diaphragm. This coil is in a closed circuit with the coil upon the permanent magnet. The two parts of the mouthpiece form the terminals of the main circuit, and they are bridged, as shown, by the bismuth diaphragm. It will be seen that the bismuth diaphragm is located in the magnetic circuit of the coil *j*, and that it is therefore subjected to the variations in magnetic force, which cause it to vary the flow of current in the main circuit.

ORGANIZATION OF THE EASTERN TELEPHONE PROTECTIVE ASSOCIATION.

At a meeting held in the Astor House, New York, representatives of various telephone manufacturing firms decided to form an association to be known as the Eastern Telephone Protective Association, and a committee is now preparing suitable by-laws and a complete plan of organization.

The immediate and most important object will be to protect the users of telephones manufactured by others than the Bell Telephone Company.

Among the manufacturers present at the meeting were A. F. Stanley, of Stanley & Patterson, New York; J. D. Leatherbee, of the National Telephone Manufacturing Company, of Boston; J. H. Scofield, of the Phoenix Interior Telephone Company, New York; George W. Coy, of the Franklin Telephone and Electric Company, of New York; H. C. Williamson, of the United Electric Telephone Company, of New York; A. H. Chadbourne, of the United States Telephone Construction Company, of Philadelphia; S. J. Tunbridge, of the Utica Fire Alarm Company, of Utica, N. Y.; James R. Strong, of the Tucker Electrical Construction Company, of this city; H. H. Douglas, of the Century Telephone Company, of Boston; Mr. Palmer, of Palmer Brothers, of Mianus, Conn.; and Mr. Wetmore of the Manhattan Electrical Supply Company of this city.

The next meeting of the Association will be held in New York on Aug. 15 at the Astor House, when the organization will be completed. The Association will be incorporated and the expenses will be borne by pro-rata assessments, and the Association will undertake to defend every individual member against suits for infringement.

CHEAPNESS OF TELEPHONE SERVICE.

Alonzo Burt, general manager of the Missouri and Kansas Telephone company, of Kansas City, Mo., has a novel plan of satisfying people who think they are paying too much for their telephones. During the day the operators keep a record of the complaining subscriber and at night know exactly how many times it has been used. A statement is made up showing the number of calls made and the number answered during the day, or the average for several days. The cost of the telephone for a year is then divided by the number of days to get the cost to the subscriber per day. A telephone that costs $72 a year costs about 20 cents a day. If the telephone has been used twenty times a day, each call has cost the subscriber just one cent or the price of a postal card. The average telephone, however, makes between twelve and thirteen calls a day and answers an equal number, which makes the cost to each subscriber whose telephone is used a little less than one cent for each conversation. The number of calls on a telephone varies. In some houses each interview costs two cents or more, while there are others that do not pay over two or three mills for each interview.

"These statements," says Mr. Burt, "show that it is cheaper to use a telephone than postal cards for any kind of business and of course it is infinitely more satisfactory."

RECENT INSTALLATIONS OF THE WESTERN TELEPHONE CONSTRUCTION CO.

The Western Telephone Construction Co., report the following new installations to be equipped by them:—

The Ticonderoga Telephone Company, Ticonderoga, N. Y., have contracted for apparatus to equip a telephone exchange for that city. They have also arranged for toll lines connecting towns along Lake George and Lake Champlain. The Elgin City Railway Company, Elgin, Ill., have closed a contract to furnish apparatus for a private telephone system. The Altoona Phoenix Telephone Co. will install complete apparatus for a telephone exchange at that point. Wapokonetka, Ohio, will have a new telephone exchange within a short time. The Wapokonetka Telephone Co. have already contracted for the apparatus. The Lansing Telephone Exchange Co. of Lansing, Mich., have contracted for 400 telephone capacity exchange, complete. Barnesville, Ohio, has fallen in line with Newark, Mt. Vernon and Chillicothe, and has contracted for complete apparatus for telephone exchange.

MIANUS ELECTRIC CO.'S NEW GRANULAR CARBON DESK TELEPHONE.

The Mianus Electric Co., of Mianus, Conn., have just brought out a new desk telephone set. This instrument is fitted with their No. 8 granular carbon transmitter that has met with such general approval for short and long distance work. The accompanying illustration shows the set which has an induction coil but is not

MIANUS GRANULAR CARBON DESK TELEPHONE.

wired otherwise, it can, however, be wired for a warehouse or any other system, where more than one cell is necessary.

The Mianus Company sell a large number of these instruments thus equipped to telephone manufacturers who wire them to suit their requirements. They are also made with push button, buzzer and receiver complete. The company also make Blake and carbon ball transmitters and the "silver chime" magneto bells.

TELEPHONE NOTES.

GALLATIN, MO.—The telephone line has been completed.

FAIRFIELD, VA.—The telephone line between Fairfield and Brownsburg is nearing completion.

SOUTH HAVEN, MICH., is to have a telephone exchange with sixty instruments.

SHELBY, MO.—The Shelby County Telephone Company will operate lines to Maud, Holliday, Granville, Paris and Hawkins.

TRENTON, MO.—The telephone line between Trenton and Laredo has been completed.

DILLSBURG, PA.—Bentz & Bailey have contracted for a number of short and long-distance telephone lines.

SELIGMAN, MO., is now connected with the outside world by telephone.

MANKATO, MINN., has granted a franchise for a competing telephone line.

NEW CASTLE, IND.—C. M. Harriman has sold the American Telephone Exchange at New Castle for $4,000 to J. W. Thompson and J. M. Maxom.

SHELBINA, MO.—Shelby County Telephone Company of Shelbina has been formed. Capital, $5,000. Incorporators—James M. McCreely, Henry Reinheimer, Thos. A. Gordon and others.

PUEBLO, COL.—Provided A. G. Holland is successful in his enterprise another telephone company will be operating in Pueblo before long.

CHILLICOTHE, O.—The Vigo, Richmondale, and Londonderry Telephone Company, has commenced running its line toward this city.

NORTH ADAMS, MASS.—The work of putting the telephone wires underground has begun under the direction of H. B. Emery, engineer.

INDIANAPOLIS, IND.—The Universal Telephone Company, of this city, are putting in a telephone exchange at Paris, Illinois, using over 100 of their telephones.

DENVER, COL.—The Strowger telephone system is to be tried in Colorado. The Colorado Automatic Telephone Company has been incorporated to operate in Colorado Springs.

IRONTON, KY., has caught the cheap telephone movement, and will positively put a new exchange in, to rival the Southern Bell. Rates are guaranteed at an average of $18 a year.

WATSEKA, ILL.—The Watseka telephone exchange, constructed and owned by W. H. Harry, has been put in successful operation.

OXFORD, NEB.—Telephonic communication between Beaver City and this place has been established. The line was built via Edison and covers a distance of twenty-two miles.

MINNEAPOLIS, MINN.—The Clark Telephone and Construction Company, of Minneapolis, has been incorporated with a capital of $800,000.

WATERTOWN, WIS.—The La Crosse Telephone Company has made a contract for 500 instruments and a switchboard to accommodate a like number of subscribers.

TRENTON, N. J.—The Standard Telephone Company, which is working up a scheme for cheaper telephones, has already secured through its Trenton agents, James N. Clemmer & Son, over 200 subscribers.

TOLEDO, O.—The plans for the underground conduits to be constructed by the Central Union Telephone company have been completed. They have been submitted to the city authorities and approved by City Engineer Clark and City Electrician Green.

TIOGA, PA.—A new telephone company is to be organized in Tioga County, Pa., to be known as the Tioga County Telephone Company. J. D. and A. R. Niles, of Wellsboro, are solicitors, and have applied for a charter.

PASADENA, CAL.—Manager Millard of the Sunset Telephone company has been actively engaged during the past several weeks on preparation for introducing the new express telephone system into Pasadena.

CLARKSVILLE, TENN.—The new telephone line to Dover, Bear Spring, Cumberland City and Erin and intermediate points, is a "sure go." The line will be built and controlled by the Clarksville Telephone Company and work will be commenced within thirty days and pushed to an early completion.

CAMDEN, N. J.—The New Jersey Standard Telephone Company is endeavoring to secure enough subscribers in this city to establish a service to compete with the Delaware and Atlantic Telegraph and Telephone Company. Greatly reduced rates are offered.

NORRISTOWN, PA.—Delaware and Atlantic Telephone Company officials are inspecting a route for an extension of their line from Collegeville through a half-dozen thriving villages to the boroughs of Pennsburg and East Greenville, on the Perkiomen Railroad, near the Lehigh county line.

ALTOONA, PA.—The Altoona Phœnix Telephone company has elected officers, as follows: H. Price Graffius, president; A. V. Dively, treasurer; John M. Hamor, general manager. The contract for putting in the new system has been let to the Western Telephone Construction company of Chicago.

JASPER, TENN.—The East Tennessee Telephone company is progressing very rapidly with its line of work through this section of the country, and Jasper is already in communication with South Pittsburg and Bridgeport. In a few days Victoria, Whitewell and Chattanooga will be connected.

SAN FRANCISCO, CAL.—The charter of the People's Mutual Telephone Company of California contemplates the building of long distance lines throughout the State and the establishment of a complete system of communication by telephone in the City of San Francisco.

WICHITA, KAS.—A blow has been struck here at the Missouri & Kansas Telephone Co. by the city council. The company refused to reduce the monthly tolls and the council imposed a license tax of $10 per month on each telephone, and passed an ordinance imposing $100 fine on any person using a telephone until the company pays the tax.

JACKSONVILLE, FLA.—The projectors of the Jacksonville Telephone company have organized a company which proposes to furnish the citizens of Jacksonville telephones at a cheap rate. The promoters of the new company are W. N. Shine and M. B. Rice, of Tallahassee; A. H. King, of Jacksonville, and A. H. King as trustee.

COLUMBUS, IND.—The Citizens' Telephone Company (the Harrison system) has completed and opened a large exchange here and has reduced the rate of the Central Union from $36 to $27 per annum for business houses, and from $36 to $18 for residences. The last named company has now announced an open rate of $12 for business houses and $8 for residences.

SHELBYVILLE, IND.—The stockholders of the Mutual Telephone Company have elected the following men who constitute the board of directors: D. B. Wilson, J. G. Deprez, J. D. Pugh, F. C. Sheldon and George Pratt. The directors then elected the following officers: George Pratt, president; F. C. Sheldon, vice-president; J. G. Deprez, treasurer; J. D. Pugh, secretary.

WASHINGTON, IA.—The Iowa Union Telephone Company, licensed by the Bell Telephone Company, have completed their lines to this city, opening up communication between the cities of Muskatine, Davenport, Columbus Junction and Burlington. From here the lines will be extended west, connecting the cities of Oskaloosa, Sigourney, Ottumwa and Des Moines.

PENDLETON, ORE.—The Blue Mountain Company are successfully operating their lines from Pendleton to the following places: East to the Indian agency; south to Pilot Rock, and Peter West ranch; north to Fulton, Warren, Helix station and Helix post-office. The line will be connected north to Vansycle within a few days; east to Mission within two weeks.

CAMDEN, N. J.—An ordinance has been passed granting permission to the Telephone Company, of South Jersey, to construct wires and maintain a telephone service in this city and giving the company the privilege of stringing wires on the poles owned by the city. For each pole erected the company will pay to the city the sum of 25 cents, and the company agrees to furnish all city officials with a telephone free.

DETROIT, MICH.—Charles Flowers, attorney for the Harrison Telephone Company has stated before Mayor Pingree that the company would not accept the ordinance granted it unless the rates of service were restored to $50 for business places, $40 for professional offices and $36 for the residences. As the rates now stand in the ordinance they are $40 for business places and $25 for residences.

GONZALES, TEX.—The Gonzales Telephone Company has been formed for the purpose of constructing and operating long distance telephone lines to points in Gonzales, DeWitt, Lavaca, Victoria, San Patricio, Nueces, Bee, Karnes, Bexar, Hays, Fayette and other counties in Southwest Texas; capital stock, $30,000; incorporators: Leslie P. David, A. J. Moore, H. C. Kokernot and others.

MONTICELLO, N. Y.—The Sullivan County Telephone Co., of which G. Christian is President and Captain E. H. Pinney, Secretary; Charles Homer, Treasurer, are going to extend their line to Monticello. They have now a complete system in Liberty which gives great satisfaction. They propose to place instruments in every town through the county and establish a central station at Monticello.

LONG DISTANCE TRANSMISSION AT 10,000 VOLTS.

(THE POMONA PLANT.)—III.

(*Concluded.*)

BY GEORGE HERBERT WINSLOW.

A short test of the Pomona circuit was made on April 11th, the results of which are given in Table I. A preliminary efficiency test on the San Bernardino circuit was made April 13th, 1893; variable load was obtained by the use of a water resistance.

An efficiency test of the San Bernardino circuit lasting five hours, during which the generator was kept at full load or overload, was made April 14th, 1893. Readings were taken every fifteen minutes, and the efficiencies and the corresponding voltages for different loads are plotted in Fig. 5. The most prominent feature of this efficiency curve is its irregularity. This is, however, satisfactorily explained by referring to the curve of generator voltages, on which it is seen that the high efficiencies correspond to high voltages and vice-versa.

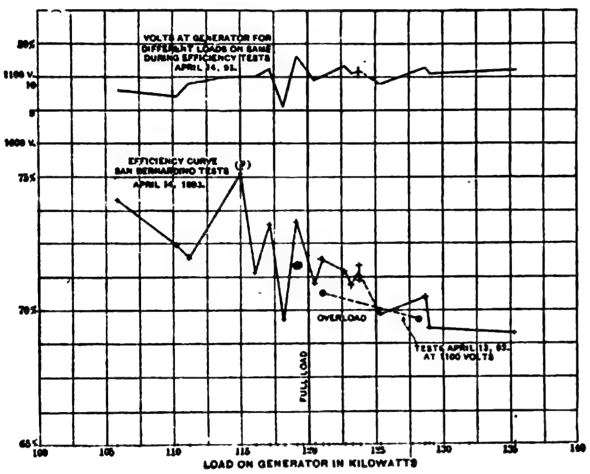


FIG. 5.

It will be noted that the apparent efficiencies shown by the preliminary test at San Bernardino agree very closely with the results of the long efficiency test there. On calculating the apparent efficiencies for different loads from data obtained by laboratory tests, and comparing them with the measured apparent efficiencies, it is found that they agree within three or four per cent. This very close agreement is exceedingly gratifying, particularly when we consider that the tests of the plant were made with ordinary commercial instruments, and that the laboratory tests were made about a year before the commercial tests.

An interesting and unique test was made May 2d, 1893, by connecting the Pomona line wires in series with the San Bernardino circuit, and transmitting about 100 H. P. to San Bernardino by way of Pomona. The length of the circuit was 85 miles, and the distance of transmission 42½ miles. This is the greatest distance yet covered by any transmission since the Frankfort experiments. The measurements are given in Table II. The apparent efficiencies are much lower than those indicated by calculations, as in the latter no account was taken of the capacity and inductance of the circuit. The voltage of the generator as measured is about 5 per cent. above that calculated, and the amperes measured notably exceed the amperes calculated. These results are attributable to the introduction of the Pomona loop, which added both capacity and inductance.

TABLE I.

EFFICIENCY TESTS. POMONA CIRCUIT.

April 11th, 1893.

Canon (20 Converters).			Pomona (18 Converters).			
Amperes.	Volts.	K. W.	Amperes.	Volts	K. W.	Efficiency per cent.
120	1100	132	105.85	919	97.28	73.7
118.5	1100	130.35	105.85	945	100.01	76 73
119.5	1100	131.45	107.4	929	99.78	75 9

In order to reduce the cost of operation, the San Antonio Company first dispensed with the sub-station attendant at Pomona after 11 P. M. This they did some time before the acceptance of the plant, after assuming the responsibility for any damage which might result. No trouble occurred and, after the acceptance (May 6th, 1893,) the same plan was put in operation at San Bernardino. After working in this way for several months, the Pomona Station was started in the afternoon and then locked up until the next morning. This arrangement was made possible by running the generator so that the lights should not be too high at Pomona, the lights at San Bernardino being kept right by the attendant with the Stillwell regulator.

In January, 1894, another 120 K. W. generator was installed with an equal capacity of oil transformers, and the Pomona and San Bernardino circuits are now each operated from separate generators with separate banks of transformers of 10,000 volts. Since this change the San Bernardino attendant has also been dispensed with, and the bookkeeper starts up in the afternoon and then locks up the station for the night, as at Pomona. The voltage of the lamps on each circuit is regulated by the engineer at the power-house, the generator pressure necessary at different loads to keep the lamps at the proper brilliancy being automatically indicated by the compensating voltmeter on each circuit. Thus after the plant is started the engineer has sole charge.

TABLE II.

42½ MILE TRANSMISSION TEST. CIRCUIT TO SAN BERNARDINO BY WAY OF POMONA, 85 MILES.

May 2nd, 1893.

Canon (20 Converters).			San Bernardino (18 Converters).			
Amperes.	Volts.	K. W.	Amperes.	Volts.	K. W.	Efficiency per cent.
95	1120	106.4	80.75	847	68 4	64.28
96	1130	108 5	78.8	865	68.16	62.82
100	1200	120.0	81.7	893	72 96	60.8

EDUCATIONAL.

APPLIED ELECTRICITY AT JOHNS HOPKINS.

One of the University Circulars of Johns Hopkins University, for 1895–6 just issued gives the syllabus of the course in Applied Electricity, and the requirements for entrance.

Especial attention is given to the electrical transmission of energy, electric traction, and alternating current work. The course includes lectures on theoretical and applied electricity and electrical measurements, with so much of mechanical engineering as seems necessary. An important feature is laboratory work, to which much attention is paid, and original investigation is especially encouraged. The instruction is given by Prof. H. A. Rowland, Professor of Physics; Dr. Louis Duncan, Associate Professor of Electricity; Mr. Hermann S. Hering, Associate in Electricity; and Mr. H. G. Geer, Instructor in Mechanical Engineering.

The course extends through two years and is intended principally for graduate students.

SOCIETY AND CLUB NOTES.

THE AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION.

The American Electro-Therapeutic Association, will hold its Fifth Annual Meeting, at "The College of Physicians and Surgeons, of Ontario," in Toronto, Canada, on Tuesday, Wednesday and Thursday, September 3, 4 and 5, 1895. The secretary of the Association is Dr. Emil Heuel, 352 Willis avenue, New York City.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES.

THE ANNUAL CONVENTION of the Association of Edison Illuminating Companies is now in session at the Hotel Cadillac, Detroit, Michigan. The first two days of the Convention, August 13th and 14th will be devoted to papers with discussions, together with any business which may come before the meeting. On the last day, August 15th, the delegates will be entertained by The Edison Illuminating Company of Detroit and the General Electric Company.

On account of the large number of short papers to be presented, the proceedings of the Convention promise to be particularly interesting, and as many new companies have been admitted a larger attendance than usual is present.

LETTERS TO THE EDITOR.

MUNICIPAL FIGURES AND MUNICIPAL FINES.

I have been greatly interested to note your recent comment, in THE ELECTRICAL ENGINEER of August 7, upon the statistics with which Prof. Parsons has endeavored to bolster up what I cannot but regard as the weak cause of municipal lighting. Those who are interested in electric lighting cannot have too much light let in upon data which, false in actuality and therefore doubly false in inferences drawn from it, is directed against the honest investments of private capital in central station work. Figures like those of Prof. Parsons are dangerous in more ways than one. They not only injure existing plants, hundreds of which have not yet earned dividends, but they tend to run communities into debt which is already more than some of them can stand. In addition to this, these figures prejudice the future of the art, for while private capital is generally ready to take up a new thing, I have rarely seen municipalities that have invested in one set of apparatus, on which a loan has been raised, anxious to make a further purchase, unless there is a chance somewhere in it for somebody to clean up a little for himself.

But I want just now to point out a set of figures which you critics seem to overlook in these wonderful municipal statistics. I never find in them any mention of rebates or fines for lights out. Now we all know that the "rebate" is a favorite club with many city officials to wield on the head of the poor local company, and that the rebate is frequently insisted upon when the shortcoming of the service is not due to any lack on the part of the company. Take the rebate charges applied to local plants and add them on to the municipal plant figures, and you would again discover the absurdity of the low figures quoted. My own impression is that because the city cannot very well fine itself, the laxity is often greater than a private plant could possibly afford, no matter how high a rate it got per light.

Then the "racket" of asserting that lights are below candle power, and withholding warrants for payment on that account is another little dodge that is worked on the local company. The municipal lights I have seen have certainly been far more open to suspicion on this account than private lights, but what does it matter, unless a political question can be made out of it, or a chance is offered to behead an official and get some other man in for a share of the plunder?

J. B.

LONG ISLAND, Aug. 9, 1895.

ECONOMY OF CONSTANT POTENTIAL ARC LIGHTING.

IN reply to a communication in your issue of the 7th inst., by Mr. W. N. Stewart, in re the "Economy of Constant Potential Arc Lighting," I must admit at the start, that my statement made in my communication in your issue of the 17th of July last, in which I said, "so far as the question of economy is concerned, the constant current system is far the more economical whether looked at from the point of view of a complete electrical installation or from that of the amount of energy consumed by the lamps in producing a given amount of light," was too broad and should have been made more specific

It was not my intention to make a comparison between the constant potential system, installed, as is usually the case, for the purpose of running incandescent lamps and as an auxiliary constant potential arc lamp, and a constant current system installed as it usually is for the sole purpose of running constant current arc lamps. I should have stated that the comparison, so far as the systems were concerned was between a constant potential system intended *only* for running arc lamps and a direct current system for the same purpose. This was implied in my communication but was not so specifically stated.

I still think that with this view of the case, the direct current system will have the advantage over the constant potential system, both in economy of first cost of plant and economy of operation. The great advantage which the constant potential system has is its flexibility and the ease with which any form of translating device can be operated upon it, and when used in this way it is undoubtedly the most economical system of distribution and translation which we have. But I doubt if any one would deliberately lay out a system of constant potential distribution for the sole purpose of running arc lamps and nothing else, and it was from this point of view that I made the statements which I did, and which I still believe to be correct, namely, that "on the constant current system, the cost of a complete installation for a given number of *arc* lamps distributed over a given area is much less than for a corresponding number of *similar* lamps operated on the constant potential system." And further, that "so far as the economy in the operation of the lamps is concerned the direct arc lamp is the most economical for a given amount of light on account of the great amount of power which has to be wasted in the dead resistance which has to be used with the lamps when operated on a constant potential circuit."

E. R. KNOWLES, E. E.

LEGAL NOTES.

TROLLEY RIGHT OF WAY IN NEW JERSEY.

Chancellor McGill of New Jersey has decided that the securing by an electric railroad company of right of way along a turnpike does not empower it to build a road there without permission of property-owners and township authorities. In the case in question, a highway between Red Bank and Eatontown, in Monmouth County, was formerly owned by a turnpike company, but was abandoned in 1891. Two years later the charter of the turnpike company was repealed by the Legislature, with the proviso that permission be given to operate a trolley road there. On the same day an act was passed designed to apply to the case, and granting to "any corporated company the right to construct roads on the turnpike in second-class counties under certain conditions." On this authority the electric railroad company tried to go ahead without regard to the requirement of the law of 1894, that the consent of the majority of the property-owners should be obtained. The Chancellor restrains the company from building the road without the required consents of the abutting property-owners and of the Township Committee, and the company can now set about getting those permissions.

THE BELL COMPANY SUES UNDER THE BERLINER PATENT.

The first suit brought by the American Bell Telephone Co., under the Berliner patent, recently sustained by the United States Circuit Court of Appeals, has been brought in Boston, against the National Telephone Manufacturing Co. The Bell Company asks for an injunction on the ground of infringement. The first hearing has been set for September 2.

LITERATURE.

Transactions of the American Institute of Electrical Engineers. Vol. XI. Cloth. Illus. 938 pp. Published by the Institute, 1895.

This large volume is certainly one of the best ever issued by the Institute; in fact we do not recall a better one in the series that now reaches such respectable dimensions. The contents are familiar to electrical readers, having appeared from time to time in the journals as well as in the admirable monthly record. We are very glad to see along with the discussions in New York, those in Chicago, which are a decided gain and will, we hope, soon be reinforced by the discussions in other local centers. Besides the papers and discussions, the volume contains careful indexes, lists of members, and a really fine portrait, one of the most faithful we have ever seen of Past President Frank J. Sprague. Altogether the volume is most creditable to the Institute, and a trustworthy pledge of its high purposes and aims.

WHEN TO DEVELOP A WATER POWER.

WRITING in *Cassier's Magazine* for August, Mr. Samuel Webber says: Persons owning desirable water powers need not be afraid to develop them, if coal costs over $2.00 per ton at the site; but in laying them out they should be governed by the minimum reliable flow of the stream, plus the amount that can be saved by night storage if it is only to be used for power by day, or for lighting by night, as such storage will double it. You may calculate on getting 80 per cent. net effect, with either of half a dozen of the best turbines, say the Geyelin, Hercules, Humphrey, Hunt, Leffel, Risdon, Swain or Victor, all of which have shown higher records than 80 per cent. With this effect you can get a horse-power net for each cubic foot of water per second on an eleven-foot fall. Do not, however, as the writer has seen done, plant a mill requiring 300 horse-power on a stream which would furnish only 100 horse-power for six months in the year, and have to haul coal from the railroad three or four miles distant to supply steam for the balance.

So much for the cost of water-power. For its value, I return to the old rule. It is worth, in any place, if it should be needed at all, what it will cost to replace it by steam, and for this find the cost of coal per ton delivered at your boilers.

For triple compound engines allow 1.50 pounds of coal of best quality per hour per horse-power, or, to be safe, say 1.75 pounds; for double compound, 2 to 2½ pounds; for single condensing, 2½ to 3 pounds; or high pressure, 3 to 3½ pounds, according to size of engine.

To the cost of fuel add wages of engineer and fireman, cost of oil, and 12½ per cent. on the cost of the plant for sinking fund, for renewal, interest, insurance and taxes, repairs and supplies, and you get pretty close to the cost of a horse-power of steam as representing the only known measure of the value of a horse-power of water.

ELECTRICITY IN DENTISTRY.—CONVENTION OF THE NEW JERSEY STATE DENTAL SOCIETY, AND THE AMERICAN DENTAL ASSOCIATION AT ASBURY PARK.

The annual meeting of the New Jersey State Dental Society, and that of the American Dental Association, which were held last week at Asbury Park, were of special interest from the fact that in the papers and exhibits evidence was afforded that the province of electricity in dentistry is rapidly increasing.

Dr. William L. Puffer, assistant professor of electrical engineering at the Massachusetts Institute of Technology, read a valuable paper on "The Electrical Principles Applicable to Dentistry"; and Mr. A. E. Woolf gave a paper on the general utilization of his system for the electrolytic decomposition of a chloride solution. This paper told of what had been accomplished by the system, its application to the treatment of germs and diseases caused by germs; and the difference in the action of coagulants on organic matter and lower forms of germ life. Illustrations were given on the screen of the difference in the action of various disinfectants and the decomposing power of Mr. Woolf's electrozone.

An interesting electrical demonstration was made by Dr. Charles A. Meeker, of Newark, N. J. Dr. Meeker bleached several teeth at once in different chairs by cataphoresis. Pyrozone was used in conjunction with an "adapter," using 110 volts.

Dr. Meeker explained that in order to accomplish the bleaching of several teeth of different patients at the same time, it is positively necessary that the teeth so presented should be free from loose decay pulps, and without nickel, amalgam, or plastic cements.

Dr. Henry W. Gillette's paper on "Electrotherapeutics of Obtunding Sensitive Dentine," was one of the most valuable communications of the convention.

Prominent among the exhibits was that of the Edison Manufacturing Company, who showed a compact and workmanlike dental plant. The exhibit, which was supervised by Mr. H. H. Shrope, consisted of a suspended dental motor, running from eight cells of Edison-Lalande battery of 500 ampere hour capacity, and 5½ volts. It is estimated that this cell will last the dentist, with a fair average amount of work, from nine months to a year. The motor reverses and, by means of a foot switch, can be made to stop instantly. As showing the capability of the motor, it is claimed that it can develop enough power to break the shaft. On the same circuit is worked a noiseless sick room fan, dentists' mallets, and miniature lamps for translumination. The exhibit included the Kennelly adapter, for use with the 110 volt Edison street circuit. This is a very beautiful instrument. It has a rheostat of German silver wire, 80 windings to the inch. It can be used for galvanic, pulsatory galvanic, and the different kinds of faradic current. One of its special features is the Kennelly amperemeter, which has been recommended by the American Electrotherapeutic Society at its last three annual meetings, as the best instrument for the physician. The Kennelly step-down transformer was also on exhibition. This is a compact device for using the alternating current for cautery work, miniature lamps, and for translumination. The step down is from either 52 or 104 volts, to 4 volts, and about 18 amperes. The Edison family and physician's faradic batteries, the cells of which give constant current, with no action of the cell except when the switch is turned, were also shown.

The W. J. Davis Electric Company, of Pittsfield, Mass., showed an alternating current motor for dental purposes, with rheostat for starting and reversing. The motor was suspended on a flexible cable, and connected direct to the armature shaft, the starting and stopping treadle being placed on the floor. The Custer electric furnace for dental work made an interesting exhibit. The Dental Protective Supply Company, of Chicago, used a Lundell motor for driving its wall bracket connecting engine.

The exhibit of the Electrotherapeutic Company, of New York, was conspicuous beyond the general excellence of construction apparent, from the fact that it contained a large number of novelties. Most of these are due to the ingenuity of Mr. G. M. Wheeler, the electrician of the company. The noiseless reversible motor, with instantaneous magnetic stopping attachment for operating dental engines attracted much attention. The disagreeable humming sound attending the action of some motors, was entirely absent. Other points in its favor are its steady power at all speeds, reversible and instantaneous stopping attachment. The action of the motor is controlled by a new treadle connecter. This is usually placed on the floor at the base of the operating chair, connections of flexible cord allowing its movement around the chair. By the action of the operator's foot on the treadle connecter the motor is run right-handed, left-handed, or instantly stopped. When started, the motor continues running until the heel of the connecter is pressed. This arrangement allows the operator to remove his foot from the treadle connecter and working from any position, to concentrate his attention on the work in the patient's mouth. The speed of the motor is varied by means of a rheostat provided with a switch arm sliding under ten contact pieces, giving as many variations in motor speed. As the motor was equipped with a 3-sized pulley, the number of variations ran from 300 to 4,000 revolutions per minute. In the extension dental engine, the bracket arm is made of aluminum, and its lightness created a pleasing impression. It is used for carrying the engine head of the dentist; it is 35 inches when closed, and 58 inches when extended to its full length.

The most notable feature of the Electrotherapeutic Company's exhibit was its current adapter, for regulating and controlling the street circuit current for galvanic and faradic current application; it is specially adapted for cataphoric work. The difficulty with this current has always been in regulating the voltage so that it could be so gradually increased as to cause no inconvenience in the mouth of the patient. This sudden abruptness of the change from one voltage to another has long been the bugbear of dentists. It consists of a nickel plated brass cylinder, 16 inches high, with a base diameter of about 6 inches. Its fibre head carries screw posts, a switch for turning on and off, and an index, which enables the operator to have always in sight the exact voltage with which he is operating. The needle which passes over the graduated scale of the index, registers up to 100 volts. The capacity of the machine is 500 milliamperes at maximum pressure of 100 volts. The gradations in current voltage are as fine as $\frac{1}{1000}$ of a volt, so that the increase is not perceptible to the patient. Speaking generally, there are two ways in which this instrument can be applied: First, locally. This application is made from a double pole electrode, having rubber cups in which cotton saturated with the obtundent, presumably cocaine, is placed. This electrode is so made that the rubber cup fits on each side of the gum surrounding the teeth. The current traverses from one rubber cup, through the gum, to the cup on the other side of the gum. With the passage of the current, the tooth nerve is anæsthetized. The tooth is then ready for extraction, or excavation, as the case may be. It is in the starting of the current that the peculiar advantage of the current adapter enters. It is started from zero and run up so gradually to, say, $\frac{1}{500}$ of a volt, that the patient does not know it is being applied. It is then raised, in waves instead of steps, to $\frac{1}{100}$, $\frac{1}{50}$, 1 volt, up to, say 12 volts, giving the average maximum current. By the time the patient has thoroughly realized that the current is doing work, the work is over. This period may be from 1 to 5 minutes according to the size of the electrode, and the temperament of the patient. The resistance of some persons to the flow of the electric current is remarkable, as doctors who are employed to watch the effect of the lethal shock at electrocutions, can testify.

The second application of the instrument is as follows: A needle-holder electrode carries a platinum needle; this electrode, used as a positive pole, is applied to cotton, saturated with cocaine with which the cavity of the tooth is filled. The negative electrode, which is the common sponge, is held at the point of the jaw on the side of the face on which is the tooth being operated upon. When the current is turned on it traverses from the needle electrode through the saturated cotton, through the dentine and apex of the tooth, and to the outer surface of the cheek, where the negative electrode is applied. These are the two principal methods in which it has been found feasible to apply this new and humane process, to the description of which and its possibilities Dr. H. W. Gillette devoted the whole of his able paper.

The new cataphoresis in dental work includes the application of pyrozone for the bleaching of teeth. This is done in the same manner as the deadening just described, with this difference, that instead of an anæsthetic, pyrozone, a commercial form hydrogen dioxide, which has powerful bleaching qualities, is used. An important device in this exhibit was the Freeman electric hot air syringe, a description of which was embodied in a paper by its inventor, Dr. S. Freeman, of New York, on "Compressed Air Apparatus in Mechanical and Operative Dentistry." This syringe is used with either compressor tank or a hand bulb, which the operator can work himself. The heating of the air is effected electrically. About half way down the syringe, within touch of the thumb, is a switch, for starting and regulating the current, which passes through a resistance attached to the syringe. An intense heat can be secured in this way; 600 degrees Fahr. have already been measured; and it is claimed that 1,000 degrees can be reached, if necessary. The syringe is used for anæsthetizing, disinfecting, or bleaching the teeth. The tooth contains about 10 per cent of water, and it has been demonstrated that when this water is removed, the normal tooth function of transmitting impressions is impaired. Such dessication is usually accomplished by heat, cold, or chemicals: Dr. Freeman finds that heat is the best. In anæsthetizing by this method, the root canals of the teeth are first dried by the stream of electrically heated air, and then the material is sprayed into the tooth, or forced through the tissues at a high pressure. In the bleaching of teeth the required conditions for the operation can be produced in one-half the usual time by the application of hot air at a high pressure, which rapidly evaporates the pyrozone, and forces it into the tubuli.

In this exhibit the Phillips electric headlight, for direct illumination was shown. Like the ordinary surgeon's headlight, it is

fitted to the head with a spring clamp; but it has, in addition, an adjustable lens, which brings the light to a focus, or diffuses it, at the will of the operator. It also has a universal joint, which throws the light at any angle, and greatly increases its efficiency. A special transformer was exhibited, made on the same principle as the ordinary transformer; but whereas the ordinary transformer is built, say, for 1,000 volts, and steps down to 50 or 100, the Wheeler device takes in the current at 53 or 104 volts, and transforms it to from 2 to 8 volts. It is specially used for cautery work, small mouth lamps, and for general faradisation. Mouth lamps, for examination and translumination of the antrum, batteries, fan motors, electrodes, and general supplies for surgical and dental work, made up an exhibit of exceptional merit.

The convention was a great success and the energy and administrative ability of the officers of the New Jersey Society were very much in evidence. Dr. Charles A. Meeker, its secretary, provided an admirable programme pamphlet for the guidance of the members, and Dr. Harvey Iredell, of New Brunswick, of the executive committee, earned the gratitude of all the exhibitors by his indefatigable efforts in their behalf.

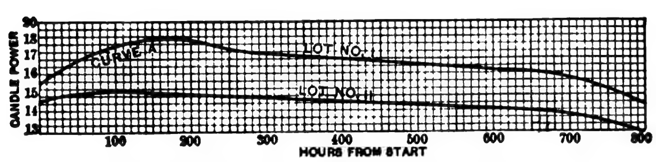
TEST OF PACKARD LAMPS.

BY PROF. B. F. THOMAS.

We have received from the New York & Ohio Co. a report of an exhaustive test of Packard lamps, made by Prof. B. F. Thomas, of the Ohio University, which will prove of interest to all users of incandescent lamps.

In order to test the lamps under commercial rather than laboratory conditions, arrangements were made with the local Edison Electric company to carry on the test on their regular circuit where the lamps would be subjected to the same variations in voltage that they ordinarily experience in practice.

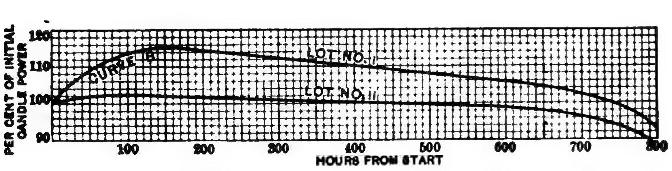
Fifty 100 volt 16 C. P. lamps were tested in two lots of 25 each. The average voltage was about 99. The photometric readings were taken with a Lummer-Brodhun photometer. The values obtained are plotted in the accompanying diagram, curve *A* showing the



CURVE "A," SHOWING CANDLE POWER.

candle power and time; curve B the percentage of initial candle power and time, and curve C the efficiency and time.

As shown by these curves, Lot I shows a marked increase in candle power on the start, reaching a maximum of 17.9 candles at about 175 hours, then decreases uniformly until 600 hours, when a more rapid decrease sets in. The candle power does not fall to its initial value of 15.54 candles until over 700 hours from the start. Lot II shows only a moderate rise in candle power, with a maximum at about 150 hours, and then decreases uniformly to its initial value at 400 hours. It shows also a sharp increase in declining brightness at 600 hours. This change may have been pro-

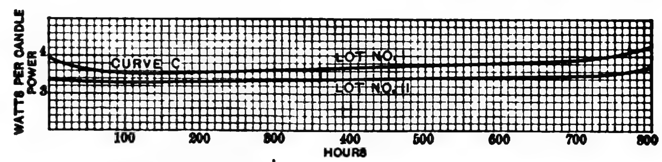


CURVE "B," PER CENT. OF INITIAL CANDLE POWER.

duced by strain due to abnormally high voltage at soon after the 600 hour point. Such a high voltage was observed for some time during the day preceding the evening on which the readings at 696 hours were taken, and its effect on the candle power of Lot I was particularly marked, though less so than on Lot II. Curve *B* shows a rise of over 15 per cent. in the candle power of Lot I, with a final value only 6.5 per cent. below the initial value. The total range in candle power from beginning to end, is 23 per cent. for Lot I, and 14.5 per cent. for Lot II.

Curve *C* shows a marked increase in efficiency for Lot I on the start, falling back to the initial value only after 600 hours. Lot II improves in efficiency also on the start, though to a smaller extent, and continues at a practically uniform figure for 600 hours. The decrease in efficiency of each lot after 600 hours is much less rapid than usual. Curve *D* shows the candle power per watt.

With the tests as a basis, computations were made as to the economy of the lamps. For this purpose the cost of the lamp was assumed at 20 cents and that of the kilowatt-hour at 20 cents. Under the conditions assumed the lamps in Lot I show a minimum average cost of the light produced by them, under the conditions assumed, at about 450 hours. Lot II shows a minimum, under the same conditions at 650 hours. The difference in cost of light produced by the two lots, at the minimum point for each lot, is about 7 per cent. in favor of Lot II. The range in candle power

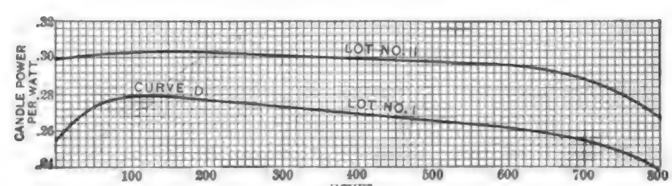


CURVE "C," WATTS PER CANDLE POWER.

of Lot I, up to 450 hours, is about 15 per cent., while that of Lot II is only 6½ per cent. up to 650 hours. Lot II is better than Lot I on this account also, as uniformity of candle power is desirable, other things being equal.

The prices used were chosen because they fairly represent lamp cost, and cost of energy as supplied by central lighting stations in this country to-day. Higher prices for lamps, or a lower price per kilo-watt hour will bring the "smashing point" for either lot later than the times named, though no change in the relative value of the two lots will follow, if compared under like conditions.

For isolated plant work, the net cost of energy is considerably



CURVE "D," CANDLE POWER PER WATT.

decreased, and may be taken at less than ten cents per kilo-watt hour—in some cases as low as six cents. For such work, the computed cost will show a minimum at or beyond 800 hours. The "smashing point" will in some cases not be the question of cost of light produced, but the decrease in candle power of the lamps being reached when the light produced by the lamps is no longer satisfactory. No lamp of either lot showed any serious blackening, and the majority of the lamps were scarcely blackened at all.

Taking economy, maintenance of candle power and freedom from blackening into account, the results obtained from these lamps according to Prof. Thomas are much superior to any heretofore published.

INFLUENCE OF ELECTRICALLY DISSOLVED GAS ON DEPOSITED SILVER.

The current number of *Wiedemann's Annalen* contains a paper by Herr J. E. Myers on the influence of gases dissolved in the electrolyte of a silver voltameter on the weight of deposited silver. The author finds, says *Nature*, as has previously been shown by Schuster and Crossley, that if the same current is sent through two voltameters containing neutral solutions of silver nitrate of the same strength and at the same temperature, one voltameter being in a vacuum, and the other in air, then the weight of the silver deposited in the vacuum voltameter is, for a solution containing from 20 to 40 per cent. of silver nitrate, about 0·1 per cent. greater than that of the silver deposited in the other voltameter. For a 5 per cent. solution the difference is somewhat smaller. If the solution is saturated with carbon dioxide, the deposit is about 0.055 per cent. lighter than when the solution is saturated with air. With nitrogen, however, the deposit is about 0.05 per cent. heavier than with air. The electrical resistance of a 5 per cent. solution saturated with air is practically the same as that of the same solution in a vacuum. With a current of more than 0.25 ampere it is found that in vacuum an evolution of gas takes place at the anode. The author has also examined the grey deposit which is formed on the anode, and finds that it consists of pure silver oxide.

"THEORETICALLY PERFECT AND PRACTICALLY USEFUL."

Mr. Edward E. Higgins, the well-known expert in street railway values and economies, writes: "I want to congratulate you very heartily on your new plan for issuing Data Sheets as a Supplement to the Engineer. I cannot see why this plan is not theoretically perfect and practically useful to a very high degree, and I shall look forward with much interest to receiving them from time to time. Please send me a filing case in morocco."

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CONTENTS.

CENTRAL STATION TENDENCIES.

THE interesting paper read by Mr. Franklin L. Pope at the Niagara meeting of the American Institute of Electrical Engineers, aside from the intrinsic value of the information it contained has still another merit in that it signalizes the fact that we have, as it were, reached a period of transition in central station practice, and that if profits are to be derived in the future, from central stations, methods will have to be adopted differing radically in many respects from those which have been considered standard in the past. While Mr. Pope's paper dwelt specifically on the changing over from a low tension direct, to a high tension alternating system, the deeper question involved in such work and in all new central station equipment, is the manner in which the generating plant shall be divided and the character of such units. The earning capacity of a station must depend largely, first on the economy of the apparatus, and secondly on the extent to which the investment involved is utilized. In discussing this side of the question in an able communication appearing in the *Railroad Gazette*, Mr. George W. Blodgett, offers the following as a means for increasing the earning capacity of a station, where there are no limiting conditions: 1. Distribute the demand for electric current uniformly over the 24 hours of the day, by transferring the excessive requirement to some portion of the day where now there is power to spare. 2. Accumulate a surplus when the plant is not taxed to its full capacity, to be drawn upon during the hours when the demand exceeds the limit of the average supply. 3. Furnish the difference between the average and the maximum requirements from a part of the plant costing less than that portion which is constantly in use.

These are sound principles, which we think will be acquiesced in by all central station engineers, but the specific means for carrying them out will probably still call for variations of the most pronounced type. Mr. Blodgett is strongly inclined to the use of the storage battery as the ideal means for carrying out the above arrangement and in this he reflects the opinions of some of the most advanced electrical engineers both here and abroad. The storage battery has certainly had a marked effect on central station work and we think we can discern its influence in a gradual tendency to return to the smaller engine unit. This again has had a reflex action on the type of engine employed in central station work and a striking example of this is offered in the description of the new Belfast station, which we print elsewhere in this issue. Here the gas engine has been applied in a manner which American engineers will do well to study closely. The high efficiency of the gas engine and the low cost at which producer-gas can now be made must secure for this type of engine a broader recognition than has yet been accorded to it.

But has the last word been said on the steam engine question in central station work? Much has been done towards bringing up the economy by the introduction of direct connected multi-cylinder engines, but recent developments point to a new and, we think, revolutionary departure in central station steam engine practice. We refer to the introduction of the steam turbine in this class of work and we need not go far to show that the turbo-generator possesses qualities which pre-eminently fit it for this particular duty. Leaving out of consideration the fact that the

steam turbine requires practically no foundation, its freedom from vibration fits it not only for central stations located in populous centres, but adapts it particularly for isolated work. But the great advantage of the steam turbine manifests itself in the fact that it occupies about one-third the height and but one-half the floor space occupied by the most compact inverted engine with direct coupled multipolar dynamos. As regards steam consumption, again, the turbo-generator can easily hold its own with the best multi-expansion condensing engine at full load, while it can do better at light loads. The tests of Professor Ewing on these points must be considered conclusive. To all these advantages must be added the reduced cost of the steam turbine and generator which can be built for about two-thirds the cost of a direct-connected multipolar unit of equal capacity. The high rotative speed of these engines will also bring us back again to the bi-polar dynamo for direct current and will reduce the number of poles for alternating current work to almost the same number. England has taken the lead in the introduction of the turbo-generator and the results obtained in that country with the Parsons steam turbine are most encouraging. It will not be long, however, before we will also be able to judge of the merits of this type of engine from actual experience on this side of the water. As has been its custom from the very start, the New York Edison Company will again do yeoman service by introducing the De Laval steam turbine into its new 12th St. station, now in course of construction, two 300 H. P. machines having been ordered for that purpose. As the station is also designed for storage battery work there will thus be afforded a fine opportunity for study and comparison of results on two points in central station practice on which American engineers are looking for additional light.

ELECTRIC LOCOMOTIVE BUILDERS.

Some months ago, discussing the changes that had then begun to make themselves apparent in the motive power of short railroads and the new conditions forced on extensive railway systems by trolley competition, we ventured to predict that at a very early date one or more of the large builders of steam locomotives would find it to their interest to engage in the work of building large electric locomotives. It was, however, hardly to be expected that the new departure would be made with the speed which is now apparent in the important news published within the last few days ; and we can only suppose either that a long study has been quietly made of the subject in unsuspected quarters, or that the revolution has come with a rush that necessitated an immediate dealing with it. Perhaps a significant incentive may be found in the remarkably small demand that has existed during the last three years for locomotives of any class, compelling observant manufacturers with large plants to cast about briskly for fresh opportunities of activity and profit.

Be this as it may, the announcement that the Baldwin Locomotive Works have joined forces with the Westinghouse Company is to be received with pleasure as one of the first signs of the new era to which some of us have looked forward. The working arrangement appears to have been shrewdly planned, and should prove easy to live up to. It is certain that no locomotive concern could plunge to-day into the middle of things electric without running the risk of serious loss from mistakes, misinformation and infringement suits ; while, on the other hand, electrical manufacturing companies have much to learn in the locomotive field and would just now have great difficulty in securing the capital for another branch of industry. We confess our preference for specialization of product, and do not believe that the electrical arts will ever reach their best until each group of products and even each article is turned out by a separate concern whose whole prosperity and future rests upon the excellence and real cheapness of its goods. The Westinghouse Company has been wise, magnificently equipped though it be, to abstain from attempting directly the execution of such heavy and difficult work as that of locomotive building.

The Baldwin Locomotive Works have always shown themselves appreciative of electrical advances, and have already done some interesting work for electrical inventors. They were among the very first of the large industrial companies to equip their shops with electric power, and lately have been adding to their plant which, if we remember aright, exceeds 400 H. P of motors in some 25 units. It is very fortunate that at the outset of electric locomotive building electricians can draw on the unsurpassed and prolonged experience of such a company, and we now look for rapid and solid advance. The action of other locomotive builders, under the circumstance, will be attended with peculiar interest.

THE BERLINER PATENT AGAIN IN COURT.

WHATEVER the opponents of the Bell Company may lay at its door they certainly cannot accuse it of chicken-heartedness, and the promptness with which it has brought suit against an alleged infringer of the recently sustained Berliner patent is proof that the Company does not care to leave itself open even to the suspicion of laches. The bringing of the suit against the National Telephone Construction Co., seems to indicate pretty clearly, either that the Bell Company does not anticipate that the Government will succeed in bringing its case before the U. S. Supreme Court, or, that if brought before that tribunal, the result will be changed. In this view we believe, they are supported by the opinion of some of the best independent legal authorities in the country. But we doubt whether the Bell Company enters upon this contest with the confidence with which its past uniform victories might well inspire it. It will be recalled that in its decision, the Circuit Court of Appeals considered only a single point among those brought forward on appeal, namely, the right of the Government to cancel a grant issued in good faith by its own officials. On this point the Court set itself squarely on record, denying the proposition in toto and hence making it unnecessary to consider any other contention looking to the invalidating of the patent. The Court expressly refrained, however, from passing an opinion on the bearing of the prior Berliner patent. On this point it will be remembered Judge Carpenter was specific, deeming the Berliner patent in controversy void on the same grounds that underlie the celebrated *Miller v. Eagle Mfg. Co.* decision.

There can be but little doubt that this will constitute the main defense in the present suit. That the telephone manufacturers are not dismayed is evidenced by the organization of another mutual protective association in the East, of which we give the details on another page. At the same time the recently organized Telephone Protective Association of America is at work and it is more than probable that one or both these associations will undertake to defend the case either directly or intervene as co-defendants.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED AUG. 6, 1895.

Accumulators:—

Machine for Making Battery Plates, Thomas T. Lewis, Philadelphia, Pa., 544,180. Filed March 23, 1894.

Alarms and Signals:—

Fire-Alarm, Charles F. Schofield, Bridgeport, Ala., 543,896. Filed Aug. 16, 1894.

Car-Signal, Joseph S. A. Bohn, Washington, D. C., 543,955. Filed Nov. 6, 1894.

Electric Alarm-Lock for Tills, Charles Helm, Indianapolis, Ind., 544,294. Filed April 23, 1895.

Automatically Operated Fire-Alarm, F. K. Ludlow, Madisonville, Ohio, 543,879. Filed Dec. 18, 1894.

Electric Signal for Railway Trains, J. C. Henry, Westfield, N. J., 543,983. Filed April 20, 1895.

A signal is made on the locomotive by opening any one of the gates, and another signal is made when all of the gates are closed. Designed for elevated railroads.

Electric High or Low Water Alarm, B. McCabe, Boston, Mass., 543,965. Filed Dec. 15, 1894.

A float operates a signal device.

Circuit Closer, W. Nutt, Crawfordsville, Ind., 543,966. Filed Nov. 6, 1894.

A track instrument for railway signals.

Fire-Alarm Signalling Apparatus, G. W. Brown, West Newbury, Mass., 544,084. Filed Sept. 1, 1892.

Magneto-Electric Bell, L. Moore, Brooklyn, N. Y., 544,107. Filed April 11, 1895.

Mechanically assists the movement by increasing the momentum of the stroke.

Electric Signalling System, C. A. Rolfe, Chicago, Ill, 544,123. Filed Jan. 8, 1895.

Embodies a street box controlled from a building.

Conductors, Conduits and Insulators:—

Method of Connecting Ends of Electric Conductors, J. T. Beswick, Brooklyn, N. Y., 543,919. Filed Feb. 9, 1895.

The ends are notched.

Electrical Conductor, G. Gray, Boston, Mass., 543,960. Filed Dec. 14, 1894.

An anti-inductive conductor consisting of a wire grooved spirally in opposite directions.

Distribution:—

Controlling Phase Relations, C. P. Steinmetz, Lynn, Mass., 543,907. Filed Sept. 9, 1893.

A phase controller coupled in circuit so as to accelerate or retard the current relatively to the electromotive force, and a regulator responsive to changes in current strength for varying said accelerating or retarding influence.

System of Electric Distribution, E. Thomson, Swampscott, Mass., 543,950. Filed June 28, 1894.

Consists of a compensating coil, an impressing circuit connected thereto, and impressed circuits fed therefrom, the connections from the impressed circuits overlapping each other.

Dynamos and Motors:—

Alternating Current Motor, E. Arnold, Zurich, Switzerland, 543,836. Filed Oct. 9, 1894.

Controls the flow of induced currents in the armature at starting, thereby producing poles and giving initial rotation to the armature, and thereafter short-circuiting the individual coils of the armature.

Short Circuiting Device for Stopping Dental Motors, F. N. Denison, Toronto, Canada, 543,855. Filed Oct. 9, 1894.

Construction of Armatures for Dynamo-Electric Machines, W. B. Sayers, Bearsden, Scotland, 543,895. Filed August 16, 1894.

Method designed to secure equal lengths of the armature coils.

Safety Electric Motor, W. R. Polk, Jr., Atlanta, Ga., 544,118. Filed Feb. 20, 1894.

Automatically cuts off the current upon its exceeding a predetermined safe point; also utilizes part of the coils of the field magnet for the variable resistance in the armature circuit.

Alternating-Current Motor, R. Lundell, Brooklyn, N. Y., 544,261. Filed Oct. 22, 1894.

An alternating motor dependent for its action upon the angular disposition of the inducing coils, said angular disposition being such that successive poles of like polarity are established slightly in advance or to one side of the poles of the field magnet and armature coils.

Electrometallurgy:—

Vessel for Electrolytic Separation, W. Borchers, Duisburg, Germany, 544,-158. Filed Dec. 31, 1894.

Refers to a vessel in which the electrolytic separation of a metal shall take place with the simultaneous alloyage of such metal with another metal in a molten state. The inner wall of the vessel is formed with horizontal grooves and projections.

Galvanic Batteries:—

Electric Battery, R. McL. and A. McDonald, Dalmuir, Scotland, 543,885. Filed Nov. 13, 1894.

Details of construction.

Primary Battery, G. H. Gardner, Boston, Mass., 543,931. Filed July 5, 1894.

In placing the zinc element into the cell, an automatic connection is made.

Lamps and Appurtenances:—

Electric-Arc Lamp, C. E. Scribner, Chicago, Ill., 543,900. Filed March 12, 1891.

A double lamp with polarized magnet to prevent the lamp burning when current is in the wrong direction.

Incandescent Conductor for Electric Lamps, T. A. Edison, Menlo Park, N. J., 543,985. Filed August 7, 1882

Composed of carbonized unstructural cellulose or other carbo-hydrate.

Process of Treating And Products Derived From Vegetable Fibres, T. A. Edison, Menlo Park, N. J., 543,986. Filed Oct. 20, 1882.

The transparent or translucent flexible material formed by treating vegetable fibre with hydrofluoric acid.

Filament for Incandescent Lamps, T. A. Edison, Menlo Park, N. J., 543,987. Filed Oct. 20, 1882.

Treated before carbonization with hydrofluoric acid.

Electric Arc Lamp, J. A. Mosher, Chicago, Ill., 544,066. Filed May 11, 1895.

The electromagnet is so proportioned that the counter electromotive force developed by it in the main line is approximately equal to the electromotive force of the service current. Intended for alternating lamps.

Measurement:—

Electric Meter, J. Harris, Lynn, Mass., 543,865. Filed Oct. 4, 1894.

Claim 1. The combination with a pressure coil and a motor, of a torsion spring connected to said coil and to said motor, whereby the torsion of the spring automatically balances the torque of the coil.

Miscellaneous:—

Store Service Apparatus, Harry M. Neer, Springfield, Ohio, 544,002. Filed Sept. 10, 1894.

Electric Temperature-Controlling Device, S. A. Ekehorn, Milwaukee, Wis., 543,929. Filed May 1, 1894.

The valve is controlled by an electric motor controlled by a thermostat one section of which is convoluted.

Electric Condenser, C. S. Bradley, Avon, N. Y., 543,978. Filed May 11, 1895.

A polyphase condenser comprising a series of conductive plates connected in groups with polyphase terminals, the members of said groups being interleaved with one another.

Temperature-Regulator, G. H Underhill and E. Glantzberg, Boston, Mass., 544,015. Filed Nov. 17, 1893.

Visual Indicating Device, C. C. Bramwell, Hyde Park, Mass., 544,034. Filed Oct. 18, 1894.

Details of construction.

Electric-Lighting System, E. F. Gavin, New York, N. Y., 544,084. Filed Sept. 28, 1894.

Relates to illuminated advertising signs.

Apparatus for Stopping Engines, G. W. Brown, West Newbury, Mass., 544,085. Filed June 3, 1895.

Automatically shuts off the steam when the steam pipe breaks.

Medical Induction-Coil, J. Tatham, Philadelphia, Pa., 544,266. Filed Oct. 15, 1891.

The current controlled by the switch may be either a primary current, a secondary current, or a combined primary and secondary current.

Railways and Appliances:

Electric Car-Brake, G. B. Damon, Lowell, Mass., 543,544. Filed April 9, 1894

A system of pneumatic brakes for electric railroads, which may be operated from the main controlling stand by the same handle which controls the car motors.

Electric Brake-Shoe, W. B. Potter, Schenectady, N. Y., 543,653. Filed March 30, 1895.

So constructed that it can be conveniently located about the car axle without removing the car wheel.

Construction and Operation of Electric Railways and Tramways, I. W. Heysinger, Philadelphia, Pa., 543,867. Filed April 11, 1892.

Passes hot air or steam through pipes close to the rails and the underground conductors.

Rheostat Controller, C. Landers, Tacoma, Wash., 543,963. Filed March 27, 1894.

Details of construction of a car controller.

Converter System for Electric Railways, T. Harper, New Brunswick, N. J., 544,037 Filed June 29, 1894.

Improvements in the primary coils and their cores, and the secondary coils, whereby permanently and always closed solid magnetic circuits may be utilized, the axes of the primary coils being parallel with the track.

Conduit System for Electric Railways, J. and W. R. Thomas, Catasauqua, Pa., 544,056. Filed Dec. 6, 1894.

Details of construction.

Trolley Wheel, J. Conway, Baltimore, Md., 544,157. Filed Jan. 4, 1895.

Electric Railway, F. Taylor, Charlotte, N. C., 544,198. Filed Nov. 30, 1894.

Details of construction.

Electric Railway and Tramway, J. Claret, Lyons, and O. Wuilleumier, Clermont-Ferrand, France, 544,209. Filed July 25, 1893.

Automatic distributors are employed to supply the current to the motors.

Switches, Cut-Outs, etc.:—

Method of and Means for Extinguishing Electric Arcs, W. B. Potter, Schenectady, N. Y., 543,892. Filed Nov. 30, 1894.

Consists in restraining the path of the arc to a line of direction transverse to the lines of force from an arc-disrupting means tending to extinguish it.

Rheostat, W. O. Meissner, Chicago, Ill., 544,047. Filed Nov. 20, 1893.

Automatic Cut-Out for Electrical Converters, W. J. Greene, Cedar Rapids, Iowa, 544,094 Filed March 9, 1895

Controlling Switch for Electric Motors, W. J. Pohlman, Woodbrook, Md., 544,236. Filed June 4, 1895.

Telegraphs:—

System of Multiplex Telegraphy, T. B. Dixon, Henderson, Ky., 543,984, Filed Oct. 19, 1894

Operates with currents of different strengths and selecting relays.

Telephones:—

Telephone, J. S. Biggar, San Francisco, Cal., 543,813. Filed Nov. 16, 1894.

For description see page 160, this issue.

Telephone-Exchange System, C. E. Scribner, Chicago, Ill., 543,901. Filed Nov. 12, 1894.

The various necessary signals from the sub-station to the central station are transmitted automatically in the use of the sub-station telephone.

Apparatus for Telephone Switchboards, C. E. Scribner, Chicago, Ill., 543,-902. Filed Dec. 8, 1894.

Object is to perform the connection and disconnection of the telephone with the plug-circuit automatically at suitable stages in the process of making connection between lines.

OBITUARY.

BENJAMIN KINKHEAD, formerly manager of the Postal Telegraph Co. at Cincinnati died a few days ago at Albuquerque, N. M., whither he had gone for the improvement of his health.

THE EDISON ELECTRIC ILLUMINATING COMPANY, of Altoona, Pa., E. B. Greene, Supt., has awarded the following contracts for the new power house and apparatus: Building, to W. V. Hughes, of Altoona, Pa.; engines to The Ball & Wood Company, of New York; boilers to the Edge Moor Iron Co., of Wilmington, Delaware; dynamos to Pennsylvania General Electric Company, Philadelphia; self-supporting stack to the Edge Moor Iron Co., of Wilmington, Delaware.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE CUTTER E. & M. CO.'S AUTOMATIC MAGNETIC CIRCUIT BREAKERS.

An automatic magnetic circuit breaker may be considered a safety valve for electric circuits. Prior to the development of a line of automatic magnetic circuit breakers, by the Cutter Elec-

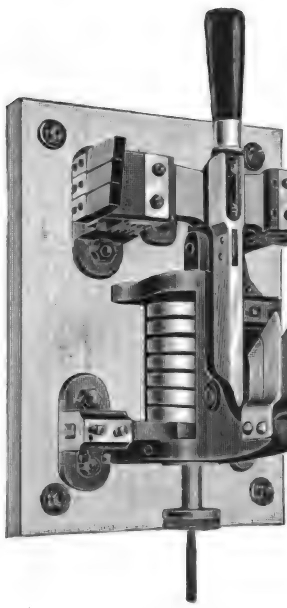


Fig. 1.

trical & Manufacturing Co., Mr. W. E. Harrington, the electrical engineer of the company, made a thorough study of the subject. The results of this study and investigation led to the design of an automatic magnetic circuit breaker which involves original features, and which has met every condition in practice imposed upon it.

Fig. 1 illustrates the standard form, which is adapted for 110–

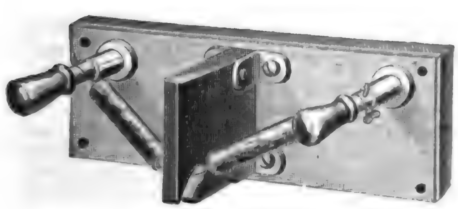


Fig. 2.

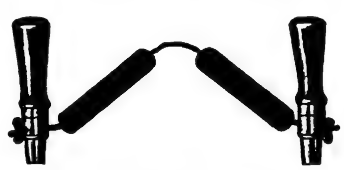


Fig. 4.

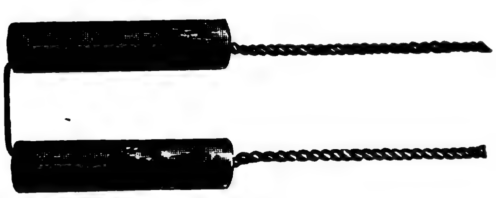


Fig. 3.

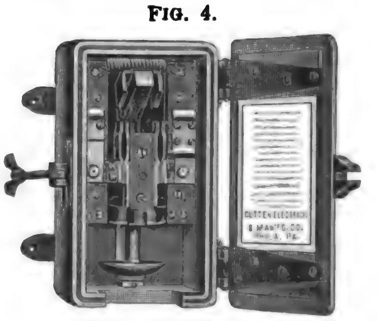


Fig. 6.

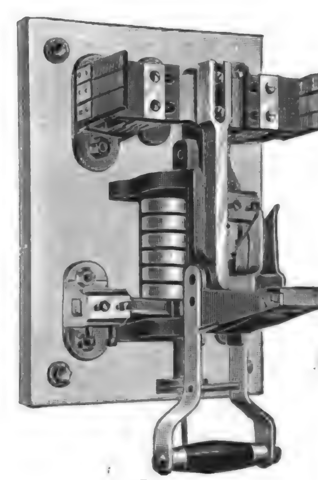


Fig. 5.

New Harrington Automatic Magnetic Circuit Breakers.

220 volt work. When employed on 500 volt circuits a fuse or shunt block, Fig. 2 is used; the protected terminal fuse, Fig. 3 is connected so as to be in shunt to the main switch break of the circuit breaker, thus preventing the destructive arcing which would otherwise occur at the switch. To facilitate quick resetting of the circuit breaker, extra plugs shown in Fig. 4 are furnished with each shunt block. The protected terminal fuses are the development of years of experimentation, and by their construction the arcing and burning of the terminals so common in the use of ordinary fuses in high voltage work is entirely eliminated.

The salient features of the Harrington automatic circuit breakers are: 1. Freedom from arcing at switch-jaws, thus preventing injury to the contact surfaces. 2. Time element; that is, the time of opening the circuit becomes less and less as the conditions of the circuit protected approach nearer and nearer a short circuit. The device will open circuit in $\frac{1}{10}$th part of a second under the latter condition. 3. Positiveness in opening: That is, if the plunger moves at all, the blow struck is, under all conditions, such that the switch will open. 4. A natural relieving of the load from the generators through the medium of the arc established at the fuse, which is so constructed as to allow of a long arc. It is manifestly incorrect to try to stop the arcing attendant upon opening a circuit by a circuit breaker too suddenly, because if too quickly opened the induced electro-motive forces tend to disrupt insulation. 5. Constancy of adjustment, which is due to weights and fixed distances. 6. Safety: Every provision is adopted to insure protection, although having fuse protection; in event of failure of fuse, or forgetfulness on the part of the operator to replace the fuse, the circuit breaker is provided with carbon final break.

Fig. 5 represents a circuit breaker with a special swinging arm handle of such a construction as to permit the placing of the circuit breaker at the top of the switch board.

The Cutter Electrical & Manufacturing Co. have appreciated the desire of the Fire Underwriters and others, and have designed a full line of circuit breakers made up roughly for house service connections, mine installations and rough factory work. This line, while employing all features and refinement of adjustment of the finer switch board circuit breakers, is made up without any finish and mounted on plain slate slabs. This rough line is made in both single and double pole patterns, in order to do away entirely with the use of a knife blade switch and fuse blocks.

Fig. 6 illustrates an automatic magnetic circuit breaker designed for the protection of car motor circuits, constructed upon the same general lines entering into the design of the switch board type.

FIRE-PROOF INSULATION.

Messrs. Aylsworth & Jackson, of Orange, N. J., the manufacturers of incandescent lamp filaments and other carbon specialties, have lately been giving attention to insulating materials. As a result, they are about to put on the market an insulating substance which has the property of smothering fire when brought in contact with it. It is proposed to use the material in the covering of electric light wires, etc.; by its use the insulating qualities are improved and the fire-proof qualities added.

PACKARD LAMPS AND TRANSFORMERS IN CANADA.

The Packard Electric Co., Ltd., of St. Catharines, Ont., announce that their new factory, on one of the finest manufacturing sites in the Dominion, is now in full operation manufacturing lamps and transformers. The factory is equipped throughout with new and improved machinery.

In order to give the business personal attention, Mr. W. D. Packard has assumed the general managership of the company, with Mr. G. A. Powell as assistant, an assurance that all orders will receive careful attention.

"COMING RIGHT ALONG."

Mr. Frank H. Clark, general superintendent of the U. S. Electric Lighting Co., Washington, D. C., writes to inquire about Data Sheets and says: "If there is another, we would like to receive it as it is too good a thing to lose."

A 78-INCH JEWELL BELT.

ELECTRICAL work has called for large belting in the past, but what is said to be the largest belt in the world is that just furnished by the Jewell Belting Co., of Hartford, Conn., to the Washburn & Moen Mfg. Co. This belt is 118 feet long, 78 inches wide and four-ply, and weighs considerably more than a ton and a half. Our engraving, Fig. 1, shows the belt rolled up as it

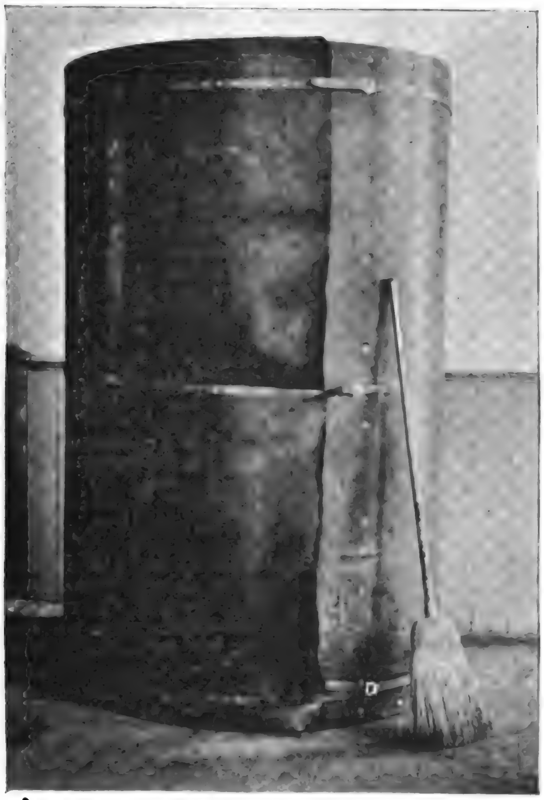


FIG. 1.—78 INCH JEWELL BELT.

appeared before shipment from the factory and Fig. 2 shows it in position at the works of the Washburn & Moen Mfg. Co. at Worcester, Mass., where the increased demand for electric wire has necessitated an increase in the power plant.

The belt will be called upon, when running its full load, to transmit 2,000 H. P. It will be used to run Mills Nos. 1, 3, 4, 7, 8,

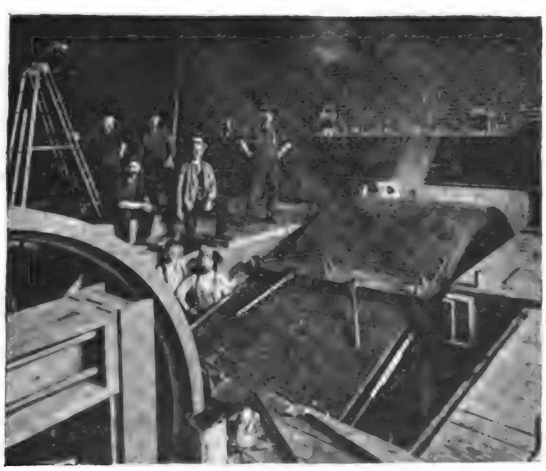


FIG. 2.—78-INCH JEWELL BELT IN POSITION.

12, 17, 18 and 19, comprising at least two-thirds of the power consumed in their Grove street works. This belt has now been running over a month, and running as true and steady as an ordinary narrow single belt.

It is worth noting that on the same day on which the Jewell Co. received the order for this 78-inch belt they also received an order for five 62-inch three-ply belts for the Cincinnati Street Railway Co. It is safe to say that the combination of the Cincinnati belts and this 78-inch belt is the largest number of very large belts ever ordered from one company in a single day.

THE BRYANT MARINE SWITCH.

THE recent successful trip of the U. S. Cruiser "Columbia," placing on record an average of 18.41 knots or over 21.5 statute miles per hour crossing the Atlantic, makes us look with pride upon our American ship builders. This ship and also the St. Louis and the St. Paul were built by Cramp & Sons, who now stand in the forefront of builders of large ocean vessels.

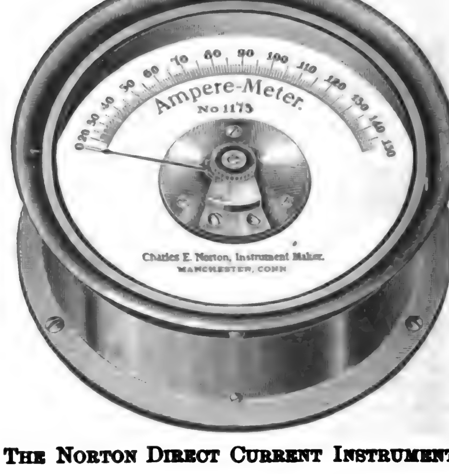
In the electrical equipment as well as in all other parts it is the aim of this company to place the best that can be had in its finished work, and many things have been designed especially for them. In the latter two vessels the switches were furnished by the

THE BRYANT MARINE SWITCH.

Bryant Electric Company, of Bridgeport, Conn., and consisted of their well-known black china switches and a special marine switch which we illustrate. This switch consists of a metal box containing a ten-ampere single pole Paiste switch mounted on a porcelain base; the holes for the wires in the metal box are protected by porcelain bushings and the box is covered with a metal top, the handle projecting. Grier Brothers, the western managers of the Bryant Electric Co., Monadnock Building, Chicago, carry these switches in stock.

THE NORTON DIRECT CURRENT INSTRUMENTS FOR SWITCHBOARD USE.

We illustrate in the accompanying engraving the type of new instruments manufactured by Charles E. Norton, of Manchester, Conn. The instruments are made so that the scale divisions are widest where they are used most, in order to give the greatest deflection for a given change of current. The voltmeter and



THE NORTON DIRECT CURRENT INSTRUMENT.

ammeter are both designed so that they can be left in circuit continuously without overheating and introducing a heating error. Special care has been taken to secure accuracy, as well as symmetry of design.

WORK OF THE SYRACUSE STORAGE BATTERY CO.

The Syracuse Storage Battery Co., Herald Building, Syracuse, N. Y., have asked us to correct a notice which appeared in our issue of July 31, which credits the installation at Dey Bros. & Co. to the Electric Engineering & Supply Co., of that city. The installation was done by their electrician, Mr. A. F. Clark, assisted by William Lalor. The Electric Engineering and Supply Company built the switch board only.

The business of the Company is improving, and they number with their recent contracts the following lighting plants: Onondaga Dynamo Co., Syracuse, N. Y.; Edwin Millner, Moosup, Conn.; Crown Mills, Marcellus, N. Y., 2 plants; Charles Fletcher, Providence, R. I., for the yacht "Seneca"; the Kansas State Normal School, Emporia, Kansas.

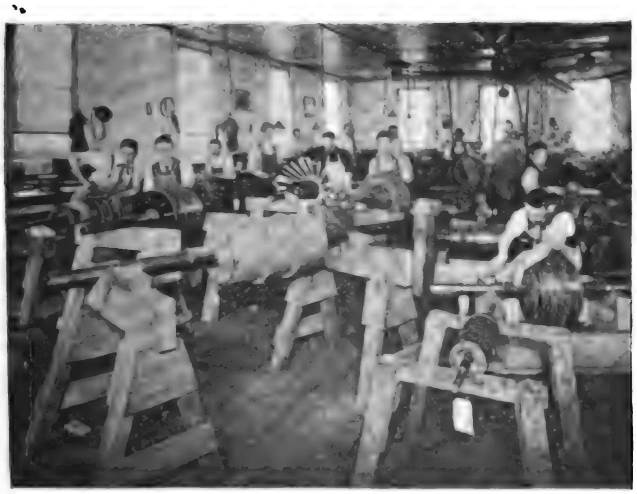
The Company will have an exhibition at the State Fair in connection with the Onondaga Dynamo Co., and the Whitman & Barnes Automatic Oil Engine. This will be a combination of home enterprise, and will be a very interesting feature.

THE CHESLEY ELECTRIC CO.

W. S. Chesley.

THE electrical field is strikingly full of self-made men, and among those who, by dint of hard work, have reached a position of responsibility and respect is Mr. W. S. Chesley. Born in 1860 at Hannibal, Mo., he received a common school education and commenced his electrical career in 1876, working six months as a messenger for the Western Union Telegraph Co., for an opportunity to learn Morse. He left the service temporarily to accept a clerkship but subsequently obtained his first position as operator in 1878. A year later he was appointed Manager of the American Union Telegraph office at Hannibal, and on the consolidation of this Company with the Western Union in 1880 he was sent to Kansas City. He soon became an expert operator and after working in several large cities was appointed Chief Operator at Little Rock, Ark., in 1882. In 1884 he was appointed Manager of the office at Galveston, Tex., the largest relay office in that section and the terminus of the Mexican and South American Cables.

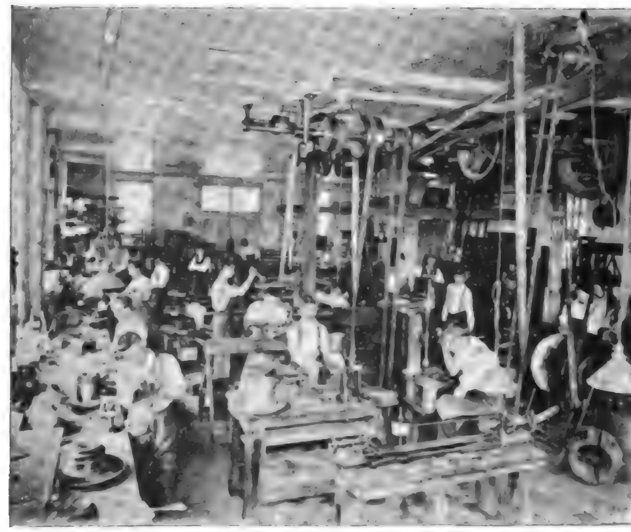
In 1888 Mr. Chesley came to New York to engage in electric



THE ARMATURE WINDING DEPARTMENT.

lighting but inexperience and poor health presented serious drawbacks. He worked about a year in the construction department of the United States and Westinghouse Companies and later acted as salesman for the Continental Dynamo Co., in which capacity he was quite successful. In 1890 he started in business for himself as electrical engineer and broker making a specialty of second-hand machines, and in 1892 opened a repair shop in Jersey City, subsequently purchasing the property in Hoboken where he is now located, two interior views of which are shown on this page.

The factory building, 75 x 85 ft., is located at Nos. 601 to 605 Newark st., Hoboken, N. J., opposite New York City. They have 28 men employed and make a specialty of repair work, more particularly alternating current apparatus, having excellent facil-



THE MACHINE WORK DEPARTMENT.

ities for handling large generators. A unique feature of this concern is the fact that they keep open day and night.

The Chesley Electric Co., in addition to repair work and second-hand apparatus has also commenced the manufacture of a bipolar dynamo with wrought iron fields which they will build up to 50 H. P.

RECENT SALES OF EDDY APPARATUS.

MESSRS. H. B. COHO & Co., of New York, agents for the Eddy Electric Mfg. Co., report the following sales of Eddy apparatus: Four 100 K. W. belt driven generators to Oscar Hammerstein for the Olympia Opera House, New York; one 60 K. W. generator to the Asbury Park Electric Ry. Co.; one 80 K. W. generator to John E. Beggs, Paterson, N. J; one 30 K. W. direct connected generator to Oscar Wiederhold; one 30 K. W. belt driven generator to the Lancaster Caramel Company, Lancaster, Pa.; storage battery plant to the New England Hotel, New York; one 20 H. P. motor to Freedman, Rennard & Company; one 10 H. P. motor to the New York Electrical Equipment Co.; one 3 H. P. motor to the Backus Water Motor Company.

BIDS WANTED.

W. B. Dunnegan, Cashier of the Polk County Bank, Bolivar, Mo., is receiving bids for an electric light plant which the city expects to put in right away.

USING A STEAM LOCOMOTIVE FOR AN ELECTRIC LIGHTING PLANT.

A SPECIAL dispatch from Westfield, N. Y., to the *Dunkirk Grapebelt* says:—It has been quite a serious question how to keep the plant running while the change of boilers was being made, but the *Scientific American* and Supt. J. G. Finlay have solved it. A Nickel Plate locomotive will be run onto the switch, back of the electric lighting building, and connections will be made with the boiler of the locomotive. This will furnish the necessary power to run the incandescent lights and no difficulty will be experienced by those who depend upon the plant for lights in their homes or places of business.

It will probably take about ten days to set the boiler, and it will cost $7.50 each night for the locomotive and engineer.

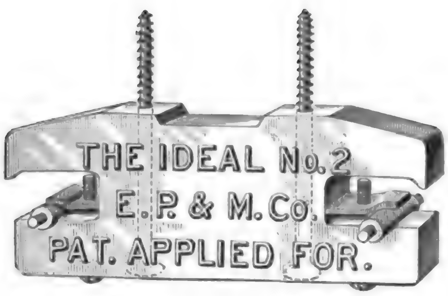
THE GULF TELEPHONE, TELEGRAPH AND ELECTRICAL CO.

This company has just been organized at Mobile, Ala., with Mr. Paul Minnis as general manager. The company will undertake contracts for all kinds of electrical construction, including telephone and telegraph lines, the furnishing of complete specifications and estimates on power and lighting plants; they will also deal in electrical supplies. The company is backed by solid business men and with the energetic Mr. Minnis at the helm will without doubt make a good showing.

THE "IDEAL" ONE PIECE CLEAT.

Our illustration represents a new one-piece porcelain cleat recently put upon the market by the Electric Porcelain and Manufacturing Co., of 309-315 Monmouth St., Trenton, N. J.

This cleat is made of white, thoroughly vitrified and tough porcelain, and besides the advantage of being self contained in one piece has a number of other characteristic features. Thus owing to the two bearings with which it is provided it will not break when secured to the ceiling. In fixing the cleat, flat head



The "Ideal" One Piece Cleat.

wood screws are used, which are countersunk in the porcelain, being fully one-quarter inch from the clamp screw. The clamp is made of stamped brass having a longitudinal corrugation which keeps the wire tight, held in position by a round-headed machine screw. The overhanging lip also protects the wire from moisture. These cleats are made in two sizes, the smaller taking wire from No. 14 to No. 6, and the larger from No. 6 to No. 0. The company have a well equipped shop for making dies and employ only skilled workmen.

SAVED BY THE FENDER.

The Philadelphia Traction Company issued on Aug. 1 a list of 16 people whose lives, it is stated, had been saved on its lines by means of the "Standard" fenders it is using.

INSPECTING ELECTRIC METERS IN CANADA.

An Order-in-Council has been passed defining the regulations for the inspection of electric meters in Canada. It provides that all electric light supply meters shall be presented for verification one-third before the 1st of December next, one third before the 1st of March, 1896, and one-third by the 1st of July, 1896. The order further provides that for every unverified meter found in use after the first of July next, the owner, that is the company, not the consumer, shall incur the penalty of $25. The fine for failure to neglect to afford the department ample testing facilities is $50.

THE GEDNEY CHANNEL LIGHTING.

With regard to our recent article on the extension of the electric lighting of Gedney's Channel, we are glad to be able to add that the originator of the system of thus lighting the channel was Capt. Winfield S. Schley, U. S. N., and that the officer who carried the work to completion was Capt. N. S. Snow, U. S. N.

NEW YORK EDISON CO.'S EARNINGS FOR JULY.

We give below the earnings of the Edison Electric Illuminating Co., for July, the statement including the Manhattan and Harlem Co.'s:

	1895.	1894.	Increase.
Gross, July..................	$ 124,181.24	$108,014.40	$16,166.84
Net, "	56,344 32	45,428 21	10,916.11
Gross, 7 months..................	$1,071,626 30	933,352.83	138,273 47
Net "	531,240.01	455,067 57	76,172 44

LOSSES OF STEAM TRAVEL AROUND PITTSBURGH.

The McKeesport, Pa. *Times* says:—The number of people of this city who daily travel over the Second avenue line to Pittsburg, led the *Times* to make some inquiries. The *Times* was informed by a Baltimore & Ohio railroad man that the company's general travel to Pittsburg from McKeesport had greatly fallen off, probably to the amount of more than a thousand tickets in a month, but that the regular monthly tickets had not fallen off. In fact, last month showed the sale of 70 monthly tickets from McKeesport, the largest number ever sold from here in one month. The monthly tickets are given at such a low figure that the company may retain that class of patrons. But it is a fact that some of the monthly patrons of the Baltimore and Ohio railroad are endeavoring to get the Second Avenue company to offer them a monthly ticket for the same price as charged by the Baltimore and Ohio, or less. In that case the Baltimore & Ohio might lose a large proportion of its monthly patrons between Pittsburg and McKeesport. On the Pittsburg, McKeesport and Youghiogheny railroad, the Pittsburg travel from McKeesport, which was light, has not been reduced very much, but the Homestead travel has fallen off very considerably.

NEW YORK NOTES.

The Abendroth & Root Manufacturing Company, 28 Cliff St., New York City, manufacturers of the Improved Root Water Tube Boiler, have been awarded the 626 h. p. boiler contract from the Union Car Company of Buffalo, N. Y., and a 500 h. p. contract from the Reading Steam Heat & Power Company of Reading, Pa. They are also erecting in New York City boilers of 300 h. p. in the College of Physicians and Surgeons; two boilers in the Baptist Home; one boiler in the Parmly Building, and two boilers for the Sing Sing Electric Lighting Company.

Mr. J. Day Flack, M. E., who has so long been connected with the engineering department of the Edison and General Electric Companies, has opened an office at 26 Cortlandt St., New York City, where he will undertake general consulting, designing and supervising work, both electrical and mechanical. Mr. Flack will pay particular attention to the supervision of electrical work for architects, the design and construction of plants for electric light and power, electric traction, electric transmission of power, steam plants and special machinery and processes for the manufacture of incandescent lamps. He is also prepared to undertake commercial tests of engines, boilers and apparatus for electric lighting or power. Mr. Flack is a graduate of the Stevens Institute of Technology and a member of the American Institute of Electrical Engineers.

WESTERN NOTES.

Mr. Wm. H. Leitch, secretary of the Abendroth & Root Mfg. Co., of New York, was a Chicago visitor last week.

The Electric Appliance Company have taken the exclusive selling agency of the United States for that celebrated commutator preserver "Gales Compound." The price has been somewhat reduced and an increased sale is anticipated.

The Fontaine Crossing and Electrical Co., of Detroit have recently sold through their Northwestern Agent Mr. F. B. Thompson, of the Rookery, Chicago, a 100 k. w. dynamo to the American Gas Engine Electric Co. This machine which it is intended to have belted to one of the new imported 150 h. p. tandem gas engines of the latter company, will be located at their plant at Lake and Clark streets, Chicago.

The Triumph Electric Co. of Cincinnati have opened an office with Turner Bros., No. 25 Marietta street, Atlanta, Ga., with Mr. E. F. Seixas, formerly with J. Holt Gates, of Chicago, in charge. Mr. Seixas will draw up specifications for complete plants of all descriptions and will install and take charge of the exhibit of the above company at the Cotton States Exposition, and will be pleased at all times to explain their apparatus to interested parties.

The Borden & Selleck Co., 48-50 Lake street, Chicago, have lately closed contracts for Harrison conveying and elevator machinery as follows: The coal storage plant and for conveying coal from cars to the two batteries of boilers for the Toronto Street R. R. Co., Toronto, Ont., the contract including a large crusher for crushing bituminous coal; coal handling plant for J. F. Clancy & Co., Racine, Wis.; coal conveyors and elevators for C. P. Wilder & Co., South Chicago, Ill.; coal conveyors and elevators for E. L. Hedstrom & Co., at their new Thirty First Street Yard, and coal conveyors for handling coal to boilers, including storage tanks; also power crusher for the N. W. Electric Transit Co.'s North Chicago power house. They report business as improving and their factory is run to its full capacity.

NEW ENGLAND NOTES.

Massachusetts Figures show that while 4103 men were employed on the street cars in the State under the old horse system, the number is now 7451; and the number of passengers has risen from 100,746,786 to 220,464,099.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

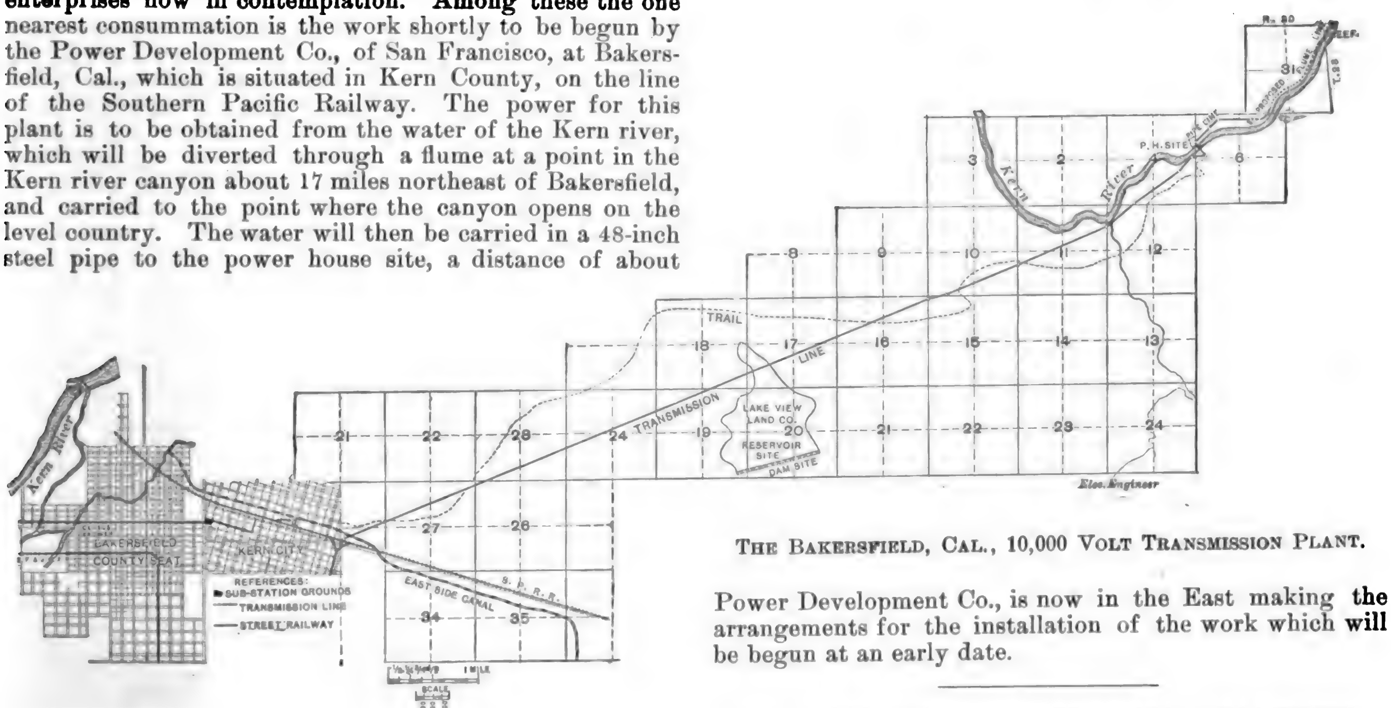
THE

Electrical Engineer.

Vol. XX. AUGUST 21, 1895. No. 381.

THE BAKERSFIELD, CAL., LONG DISTANCE POWER TRANSMISSION.

THE high cost of fuel prevailing in most parts of California, has turned enterprising capitalists to the utilization of the numerous water-powers which abound among its mountains. Our readers will recall the Pomona plant and the recent inauguration of the Folsom-Sacramento transmission plant, which may be said to be the pioneers of many similar enterprises now in contemplation. Among these the one nearest consummation is the work shortly to be begun by the Power Development Co., of San Francisco, at Bakersfield, Cal., which is situated in Kern County, on the line of the Southern Pacific Railway. The power for this plant is to be obtained from the water of the Kern river, which will be diverted through a flume at a point in the Kern river canyon about 17 miles northeast of Bakersfield, and carried to the point where the canyon opens on the level country. The water will then be carried in a 48-inch steel pipe to the power house site, a distance of about 4,200 feet, at which place the head will be 240 feet. The power house site is about 15 miles by wagon road northeast of Bakersfield. These locations are shown on the accompanying map.



THE BAKERSFIELD, CAL., 10,000 VOLT TRANSMISSION PLANT.

There will be installed in the power house generators of not less than 1,200 H. P. capacity to be direct driven from water wheels (provisions being made for increasing the capacity at a later date). The power house is to be connected with a sub-station in Bakersfield by a transmission line of 1,500 H. P. capacity, at a loss in line of not more than 10 per cent.

The length of the transmission line from the power house site to the town limits is about 11½ miles and from the town limits to the sub-station about 1.8 miles; the line will be run in two independent circuits. Besides the power conductors, there will be strung on the poles a No. 12 copper, twin twisted telephone cable.

At the sub-station in Bakersfield there will be installed step-down transformers which will reduce the line potential of 10,000 volts to 2,000. These transformers will have a capacity for supplying 1,000 16 C. P. 60 watt incandescent lamps and 180—2,000 C. P. alternating current arc lamps. In addition there will be installed a constant current arc machine with a capacity of 100—2,000 C. P. lamps which will be driven by a synchronous alternating motor, and two rotary transformers, of a combined capacity of 100 H. P. at 550 volts pressure direct current.

Besides the distribution of light and power the company will also operate an electric railway between Bakersfield and the adjoining town of Kern. The initial equipment will consist of four motor cars and four trailers.

Mr. Carroll N. Beal, secretary and treasurer of the Power Development Co., is now in the East making the arrangements for the installation of the work which will be begun at an early date.

THE SABIN-HAMPTON "EXPRESS" TELEPHONE SWITCHBOARD SYSTEM.

A PECULIAR feature of the telephone business has been that the cost per subscriber of central office equipment is much greater in large than in small exchanges. The cause of this remarkable condition, so different from ordinary experience in business where magnitude of operation goes hand in hand with relatively decreased working expenses, is to be found in the employment of the "multiple" system of switchboards. That is a point long since thoroughly appreciated, but one from which there has seemed little prospect of relief. The multiple board, by reason of its greater efficiency over other and earlier attempts to cope with the rapidly-increasing tide of telephone business, was adopted in spite of its cost. It was a case of efficiency against economy, and efficiency won.

Since the introduction of the multiple system, however, telephone switchboard development has been distressingly slow; the aim of inventors evidently being mostly directed on minor points on old lines rather than on original work in new directions. It is not the intention here to assign the reasons for this case of arrested development. It is sufficient to point to the facts as they are, and indicate by a brief statement the underlying principle of the multiple board

with its shortcomings in order to better understand the advantages possessed by a new departure in this field.

The essential principle of the multiple system is that all subscribers' circuits are accessible to any operator in an exchange. That is accomplished by furnishing each subscriber's circuit with numerous springjacks, one of which is within reaching distance of any operator, regardless of her working position. This repetition of working parts produces great complexity, which is much increased by the necessity of providing a busy test at every jack, so that while a line is in use it may be free from interruption.

It is unnecessary to describe the means adopted to obtain this, further than to say that on every jack there is a point which is automatically connected with a battery at the proper time. By touching the point with a plug an operator can, by the presence or absence of a click in her receiver, determine whether a line is busy or free. In spite of this precaution, it is a fact that lines are frequently interrupted, to the great annoyance of all concerned. The opportunity always open to careless operators to make mistakes of this sort is undoubtedly the cause of much popular dissatisfaction with the telephone service furnished in large cities.

To obviate some of these defects of the multiple board, Messrs. Sabin and Hampton, of San Francisco, have designed a system known as the "express" system of switching, on radically different lines.

It may be well, first of all, to state here the most prominent points of difference between the two systems.

In the multiple board there are many working parts in each circuit, involving the use of a "busy" signal. In the Sabin-Hampton board there is no repetition of working parts and consequently no need for a busy test. In the multiple type of board everything is designed to permit the operator who answers a call to complete a connection unaided; while in the system under consideration the work is divided among three operators, each having a special function to perform.

In the accompanying diagram which illustrates the "Express" system, a calling subscriber is represented in electrical communication through the exchange with another subscriber; but in order to better understand the manner in which this is accomplished let it be supposed that the calling subscriber has his receiver on the gravity switch; that plug 1 is not in jack 1; and that the springs of the jack rest on the inner contacts leading to drop 1, and subscriber's signal battery, which is the normal condition.

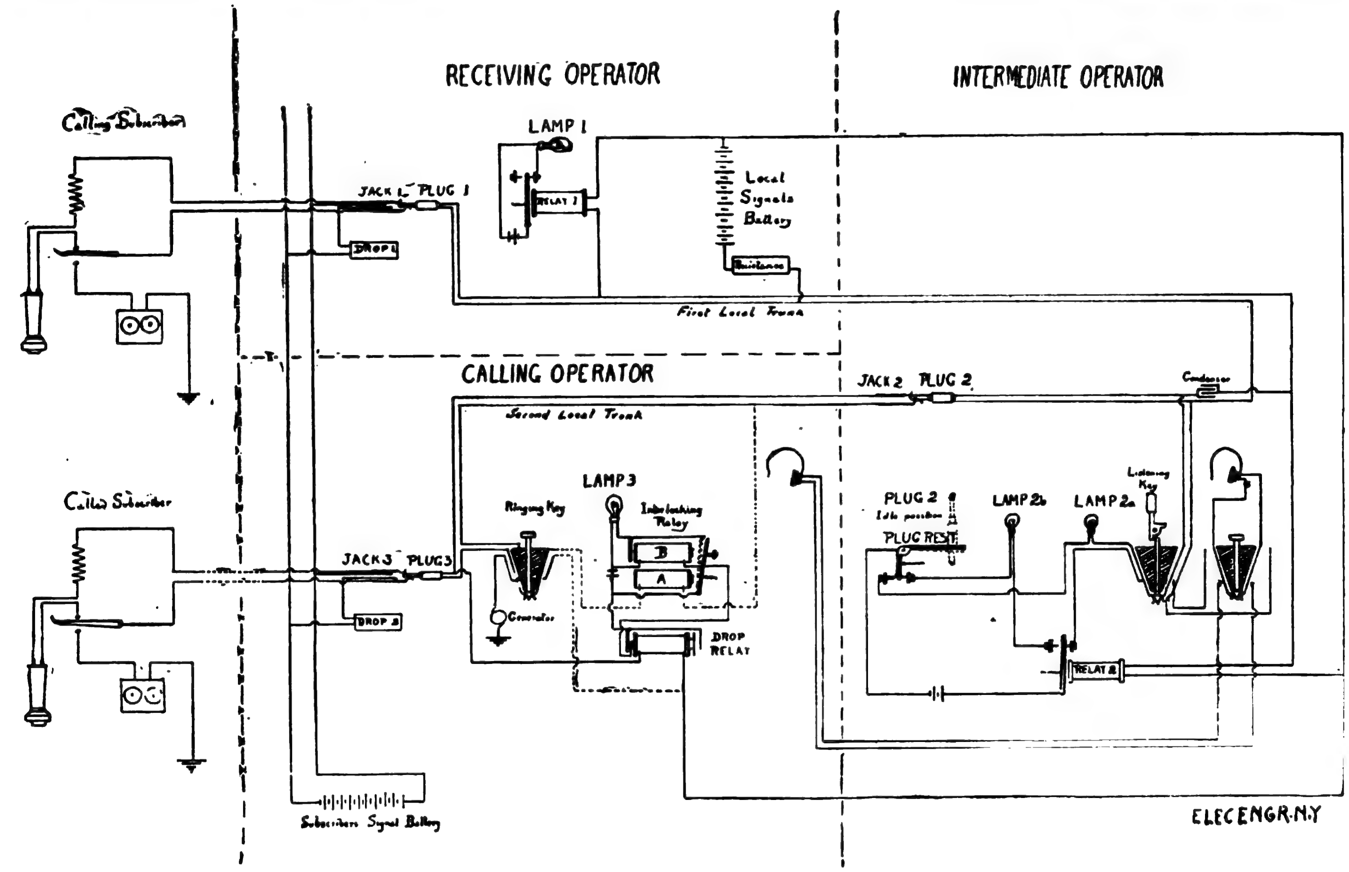
In order to call central under those circumstances, all that it is necessary for the calling subscriber to do is that he take his receiver off the hook, thereby closing his circuit through his receiver and secondary, and throwing drop 1 by the current from the subscriber's signal battery. It should be noted that no magneto is used by the subscriber.

The "receiving" operator, noticing the call, inserts plug 1 into jack 1, which breaks the drop circuit, restores the drop, and extends the subscriber's line through the first local trunk to the "intermediate" operator. Further than that she has no concern with the call other than to clear the connection when the conversation is finished.

The intermediate operator is notified that some one is calling on the local trunk by the lighting of lamp 2*a*. The working of the lamp will be described presently.

Pulling down the listening key, the intermediate operator puts herself in communication with the calling subscriber and, finding out whom he wants, presses her local calling circuit key, of which she has several, and requests the calling operator, who has the desired subscriber on her case, to put him on one of the second local trunks. The calling operator states what second local trunk is to be used, and the intermediate operator puts plug 2 into jack 2, which extends the line of the calling subscriber to the case of the calling operator.

The calling operator then completes the connection by inserting plug 3 into the jack of the called subscriber.



The Sabin and Hampton "Express" Telephone Switchboard System.

The calling operator next presses her ringing key and sends out current from the exchange ringing generator through one side of the subscriber's line to the gravity switch, supposed to be resting on its under contact, to the subscriber's call bell and thence to ground. The called subscriber by taking his receiver off the gravity switch is then in communication with the subscriber calling him.

It now remains to describe the manner in which the operators are notified of the beginning and end of a connection.

That is done by means of the lamps, 1, 2 *a*, 2 *b*, 3, and the shutter of the drop relay. So long as the calling subscriber's receiver is off the gravity switch and plug 1 is in jack 1, relays 1 and 2 are energized by the local signal battery, as they form bridges across the circuit. Lamp 1, therefore, is lighted during the entire conversation. Until the intermediate operator pulls down her listening key, lamp 2 *a* is lighted and will relight if she should raise it without lifting plug 2 from its idle position. Lamp 2 *b* lights when the calling subscriber hangs up his receiver as relay 2 is then demagnetized. Lamp 2 *b* is equivalent to a ring-off drop.

The signals of the calling operator are controlled by the called subscriber. They would be controlled in the same way as those of the receiving and intermediate operators were it not for the condenser in one side of the first local trunk. On pressing the ringing key, magnet A of the interlocking relay attracts its armature and completes a local circuit through lamp 3, which remains lighted till the called subscriber answers.

When the drop relay acts, as the result of an answer from the called subscriber, the magnet B of the interlocking relay releases the armature of A, and the lamp goes out.

The calling operator is notified of the close of the conversation by the fall of the shutter of the drop relay.

It will be apparent from the above description that every part of the connection has its proper signal. Being automatic, there is no necessity for the operators wasting time in supervising connections, as is invariably the case where the ring-off signals are dependent on the thoughtfulness of the public.

For the sake of simplicity it has been represented that there are receiving and calling operators. As a matter of fact the same operators do both kinds of work. Receiving calls simply consists in turning over all calls to the intermediate operators for distribution amongst the calling operators. It can be done with no appreciable delay to calling business.

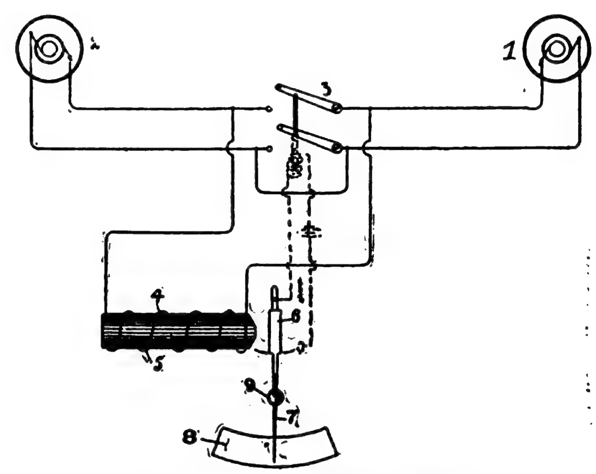
The "Express" system has been introduced into the San Francisco telephone exchange, where it has given excellent satisfaction.

THE MERSHON SYNCHRONISM INDICATOR.

In order to connect alternating machines in parallel to the same circuit they must be at the same phase, or in synchronism, and in order to determine this point various devices have been employed. Thus in some cases an acoustic indicator is used, while in others an incandescent lamp placed across the terminals of the machines to be connected is observed, and when at its greatest brilliancy the switch is thrown. The point of greatest brilliancy in an incandescent lamp is somewhat difficult to determine except by experience, and with the object of supplying a device which can be read off with accuracy by the ordinary station attendant, Mr. Ralph D. Mershon, of the Westinghouse Company, has devised the arrangement shown in the accompanying engraving. This indicator has the advantage also of being equally well adapted for alternating circuits of high and low frequency; the acoustic indicator being unavailable for frequencies below a certain limit.

The indicator consists of a coil 4 connected to the machines as shown and acting upon an armature which carries a pointer passing over a scale. The armature may be either of iron or consist of a closed coil or a disc of non-magnetic material; in the latter case being acted on inductively. Assuming the coil 4 to be so connected in circuit that the electromotive forces therein will be in opposition when the machines are in the proper relation for closing the switch 3, the armature 6 will, in the absence of such relation, be moved either toward or away from the coil 4 and its core 5, the direction of such movement being dependent upon whether the armature be of magnetizable or non-magnetizable metal. As the two machines approach the same speed and the electromotive forces come more nearly into opposition, the armature will tend to return to its original or zero position until the relation of the machines is such that they may properly be connected in circuit, when the armature and its pointer will be in approximately the position shown in Fig. 1.

If, on the other hand, coil 4 be so connected in circuit



MERSHON SYNCHRONISM INDICATOR.

that there shall be a coincidence of the electromotive forces therein when the machines are in the proper relation for connecting them in circuit, the operation of the device will be the reverse of that above described—that is to say, if the armature be of magnetizable material its extreme left-hand position will indicate the time for closing the switch, and if of non-magnetizable material its extreme right-hand position will give the proper indication, the vertical or zero position, indicating the absence of the desired relation of the two machines.

Mr. Mershon prefers to so connect the coil in circuit that there shall be an opposition of elecromotive forces therein at the proper time for throwing the switch and to employ a non-magnetic armature; but the other connection and variety of armature described are entirely practical and may be employed. It is obvious that the armature or its pointer may also serve, if desired, to close a circuit, which shall operate to effect the closing of the switch automatically.

THE DURABILITY OF ASPHALT CABLES.

Herr Görz, of St. Petersburg, writing in the *Elektrotechnische Zeitschrift* on the proposed German wiring rules, and proposing several amendments, refers to the question of the durability of insulated cables. He states that the whole underground network of the St. Petersburg Electric Supply Station consists of lead-covered asphalt Siemens-Halske cables, which have been working for the last six or seven years to entire satisfaction. The expenditure for repairs and renewals for the last year was only ½ per cent. of the total expenditure of 1,100,000 silver roubles on cables.

BUFFALO BILL'S PORTABLE ELECTRIC LIGHT PLANTS.

BY

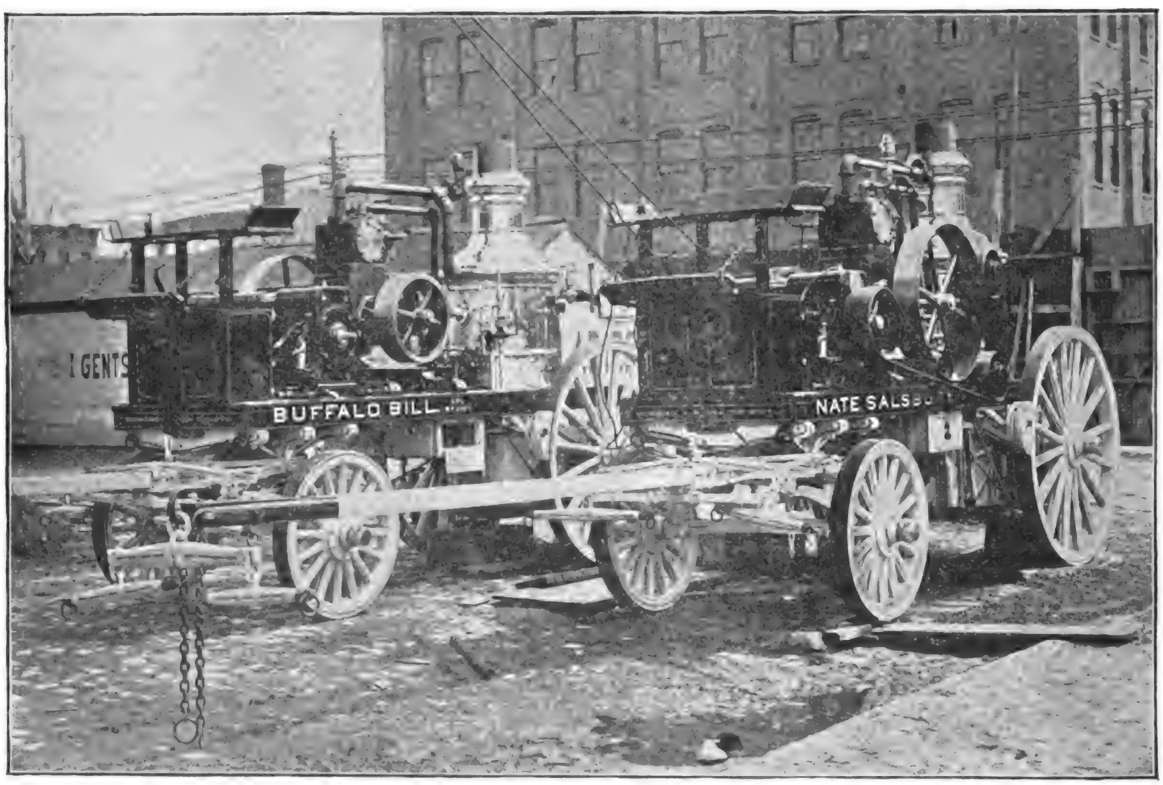
Frank B. Widmayer

VERY early this season the managers of the Buffalo Bill Wild West Show Co. considered the advisability of generating electricity for illuminating their show at night. This seems a very simple matter but under the circumstances it was a very difficult one—as the show has no permanent location this season but is on the road and is exhibiting in all the large cities and towns of this country; the number of nights of its stay in a town or city depending upon the size of the town and ranging from a one night's stand to two or three weeks. The Buffalo Bill Company consulted their electrical superintendent, Mr. M. B. Bailey, submitting the question whether it was not possible to build two portable electric light plants, alike in every respect and each being capable of running from 25 to 30 2000-candle power commercial arc lamps; each plant to operate an independent circuit; every alternate lamp to be connected to the circuits so that if anything went wrong with one plant they would be able to run half the lights and so light up the show that a fairly satisfactory performance could be given. It was further required that the plants be so constructed that upon reaching the ground where the show was to be exhibited that night, the complete plants, consisting of poles, line work, lamps, engines, boilers, dynamos, etc., could be set up and in running order inside of two hours; and after the show was over the complete plants could be taken down and loaded on their special cars ready to move to the next town inside of two hours. To these were added the further conditions that the various parts and the wagons should be light enough to be easily handled over ordinary roads by two or three horses.

In reply to these rather rough specifications Mr. Bailey said he was sure he could accomplish just what was wanted—and he was told to go ahead.

A great many plans were submitted to Mr. Bailey and the officers of the Wild West Co. by various electrical and mechanical engineering firms and, as there was very little precedent for such work, the plans and suggestions, as might have been expected, were widely apart. A decision was finally arrived at and the Ball Electric Light Co. of New York undertook to furnish the complete electrical plant, and all the novel and special electrical details connected therewith. The steam or power plant was built under Mr. Bailey's personal supervision.

The Ball Co. and Mr. Bailey working together finally designed and built the two novel plants shown in the accompanying engraving. These represent two duplex plants of 28 lights each. Each plant consists of a strong wagon. Supported on the wheels by heavy springs are two I-beams with cross bracing, forming the truck frame. Set below these beams on the rear axle is a burnished steel, copper tube Clapp & Jones fire engine boiler—of the type used by the fire departments of all our large cities. To this is piped a 25 horse-power automatic high-speed cut-off Case engine, which has proved to be a model of efficiency for this special duty, as it is light and very compact in proportion to its power, as is also the boiler. Connected to the boiler is an injector and a Worthington "Baby" feed pump. All the pump, dynamo, and engine fittings are nickel-plated and the iron work of the truck is heavily japanned and decorated, presenting a very attractive appearance.



BUFFALO BILL'S PORTABLE ELECTRIC LIGHT PLANTS.

In front of the boiler on the I-beams is mounted one automatic Ball 28-light, 10 ampere series arc dynamo,[1] which is insulated thoroughly from the base or truck, and it is provided with special self oiling dust proof bearings, etc. This machine is only 53 inches long, 24 inches high and 20 inches wide, and weighs about 1,500 pounds, being like the engine very, compact for its capacity.

1. This machine was fully illustrated and described in THE ELECTRICAL ENGINEER of March 20, 1895.

In front of the machine is the switchboard, which is located below the seat, and hence cannot be seen in the engraving. On this are mounted all the electrical instruments necessary for the proper operation of the plant, including a special portable ampere-meter reading up to 20 amperes—two Garton magnetic lightning arresters, a short-circuiting field switch, line terminals, etc.

The system of transmission of power between the engine and dynamo is by belting—an endless belt being used in connection with the L. P. & D. transmitter, which seems to be particularly adapted for a portable plant built as compactly as this one is. The weight of each plant complete, with its load of engine, boiler, dynamo, all fittings, coal and water, is about 5¼ tons, and this weight is properly supported by springs on special heavy wheels having 5 inch tires.

Both wagons appear in all street parades and they create quite a sensation among the electrical and mechanical community wherever seen. They can be easily handled by two horses, although six are generally used for street parade effect.

Both these plants have been in nightly operation for the last five months without a mishap or interruption of any kind. When it is considered that they have worked directly exposed to heavy thunder storms and in torrents of rain without the slightest protection from the weather, without the loss of an armature, the quality of the workmanship and insulation of the Ball dynamos needs no further pointing out.

It may be of interest to call attention to the reflecting arc globe used in connection with this plant, and designed by Mr. Bailey. This globe is a combination reflector and globe, and consists of two hemispheres; one of these is blackened on the outside and corrugated on the inside and silver plated, thus forming a very good reflector. The other half forming the front piece is of clear glass. These globes give an excellent diffusion of the light.

These plants will visit nearly all the important cities in the United States before the season closes and Mr. Bailey or Mr. B. C. Killin, the engineer-in-chief, will both be only too glad to explain and show them in all their details to any one interested. The writer sees no reason why such plants should not multiply rapidly as there appears to be a good field for them among contractors during night operations, and for military purposes.

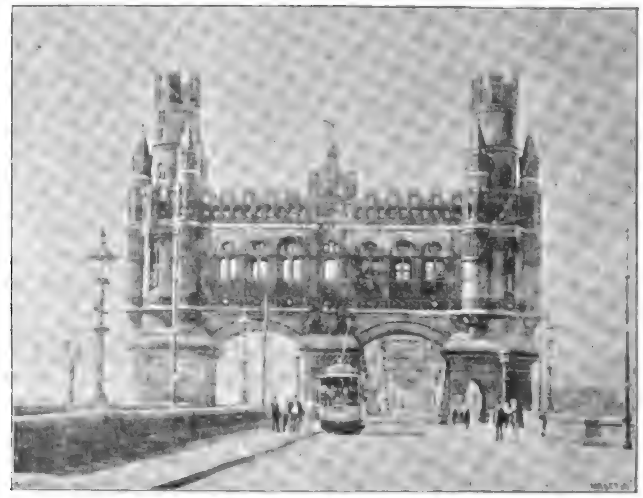
ROUNDABOUT NOTES IN ELECTRICAL EUROPE.—III

BY

HAMBURG.

The city of Hamburg is one of the oldest, most prosperous and beautiful of the many cities which abound in Germany. It has made enormous strides and its population is estimated at between 300,000 and 500,000, authorities differing. Its commerce is world-renowned and in its busy harbor ships of all nationalities are moored. Its merchants are in touch with almost every land and either export to, or import from everywhere. Evidences of prosperity are visible within her borders, and Hamburg boasts that no beggars infest her streets. Money is not so closely scanned here as it is farther South, and it is spent freely. When Emperor William passed through here to open the North Sea Canal, he found the generous residents had built a beautiful island in the centre of the lake, on piles, covered them with wire and stucco work, and erected a pavillion for royalty to drink coffee in and look around. This island was called the King's Island, cost $40,000, and was demolished after the Kaiser passed on. It was illuminated by incandescent lamps and search lights furnished by the electrical engineering establishment of Schuckert & Co., of Nuremburg.

Naturally people who go in for luxuries of this sort are likely to be good patrons of an electric road, and Hamburg has a system of which it may justly be proud. It



Side Pole Construction, Hamburg Electric Railway.

resembles an ideal American overhead road, more, perhaps, than any we have seen abroad. The road has about 50 miles of track, and extensions of some 30 miles are in course of construction; 160 cars are in service and in a few weeks 40 additional will be delivered. In time it is expected that there will be at least 300 in all.

The entire equipment was furnished and all construction was done by the well-known Union Elektricitäts-Gesellschaft of Berlin, of which Mr. Louis J. Magee, formerly in the United States, is managing director. Their well-known type of motor is used. It works beautifully and runs silently and without heating. The Messrs. Schuckert & Co. are expecting to lay about 6 miles of electric road on which they will operate their own motors, but this line is quite separate from the main Hamburg

Double Bracket Construction, Hamburg Electric Railway.

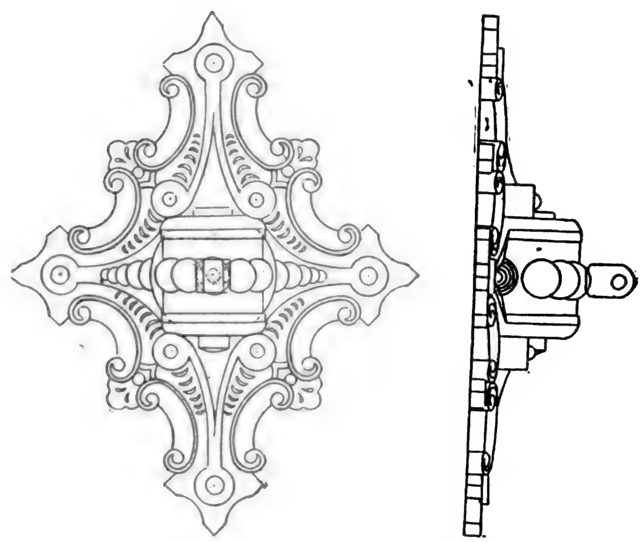
company. The daily receipts of the latter now average about $4,000, and on Sundays and holidays this increases to as high as $5,700.

Before the Company can accept a car or operate it, the Inspector of Police must approve of the car and sanction its use. The inspection is rigid and it is apparent

that the difficulty of making innovations, or introducing unknown types of apparatus, is great. Even if the railroad company wants an article, it can not put it in use without official consent.

The rails are supplied by the well-known Phœnix Co., whose works are located near Cologne. The trucks were built by the Remscheider Steel and Industrial Works. The street railway company builds its own cars in a very completely furnished plant of its own in the city. One hundred and twenty men are employed, but in addition to making repairs, these men only turn out 4 cars per week. The work is heavy and likely to be durable. A private car in process of finishing would do credit to any American car builder.

Some fine overhead work was done here on the bridges and in a square where no poles were allowed. By a re-inforcing wire arrangement the line is carried a long distance without any support from poles. A very important thing in the construction work is the great extent to which rosettes are used. These rosettes, as the accompanying illustration shows, are highly ornamental and very useful, too. Over 4,000 are in use and of course they save just that many poles. The streets are not so obstructed when the rosettes are used and they cost less than one-half the price of poles. They are properly insulated and are fastened into the masonry. Not only are they found on residences, warehouses and other buildings, but on the Kathrina and other churches, as well, and they certainly do not mar the walls. When the road was being built, the church authorities were given the option of having either poles or rosettes, and they wisely preferred the rosettes overhead, to the poles on the pavement in front of the sacred edifices.



Rosette for Trolley Suspension, Hamburg, Germany.

The motormen make but $21 to $24 per month and are furnished one uniform per year gratis by the Company. The conductors are paid less, but tips are given them by passengers, so they make more than their wages in tips. The cars here are heated by bricks which, when warm, are shoved into the place provided under the seats, much as accumulators were arranged in the old Julien cars on 4th avenue, New York. Hamburg uses German trucks but Bremen near-by uses the well-known Brill trucks. There is no provision whatever for ventilation. The windows of all cars are screwed fast and cannot be raised or lowered. If fresh air is demanded, the front door is opened and it comes in by wholesale. No modern sand box is used, but when sand is needed it is shoveled from a box; the car is stopped and sand distributed.

The fender arrangement on the Hamburg cars is very bad and gives no protection whatever. It would really suck a victim into the space under the motors. Its edges are made of ship's rope.

The first car began running on March 5, 1894, and it is very remarkable to notice how finely equipped the system is and how admirably it taps the important centres.

Electricity is about to displace steam on the Wandbek route. This part will also be equipped by the Union Electricitäts Gesellschaft whose interests here are carefully watched by their local manager, Mr. Emil Bjorkegren. It is interesting to know that this accomplished gentleman obtained his electrical training originally in the Thomson-Houston Co.'s shops in Lynn. This helps to account for the up-to-date customs and the speed of 12 to 15 miles per hour cars make. The Americans are looking with longing eyes to trade with Germany and we noticed that the dining car en route to Vienna was built at the Jackson & Sharp Co.'s works in Wilmington. There appears to be no good reason why American street car builders should not be able to furnish electric cars to Germany, considering the experience they have behind them.

In the car company's hospital a curious relic is shown. It is one of the old omnibusses some of which are still in use. There are four wheels with which it runs along the car track and then there is a fifth wheel which can be raised or lowered. When the bus is running properly, its fifth wheel is raised, but should the bus run off the track the fifth wheel is lowered and by its aid the bus is again put back on the track.

THERMO-ELECTRIC PHENOMENA BETWEEN TWO ELECTROLYTES.

M. Henri Bagard in the *Ann. Chim. Phys.* writes that in continuation of his researches he has determined the thermo-electric E. M. F. in the cases of a number of couples consisting of two electrolytes. The E. M. F. is in all cases, as with the metals, a function of the second degree of the temperature, and very frequently the existence of a neutral point was observed somewhere between 0 deg. and 75 deg., the limits of temperature of the experiments. In the case of two solutions of the same salt of different degrees of concentrations, the current always travels across the heated junction from the dilute to the concentrated solution. Becquerel's law of intermediate substances and the law of intermediate temperatures are found to hold good. There is a simultaneous inversion of the thermo-electric E. M. F. and of the Peltier effect at the point of contact of the two electrolytes, and an electrical transference of heat in these liquids.

LIMITS OF ELECTROLYSIS.

M. Marcellin Berthelot, in *Ann. Chim. Phys.*, states that he has formerly shown by experiment that in the electrolysis of an alkali salt, of which neither the acid nor base is oxidized or reduced during the operation, the minimum E.M.F. necessary for electrolysis is the sum of two equivalent quantities—the one being the heat absorbed in the separation of the acid and the base in dilute solution, the other the heat of decomposition into oxygen and hydrogen of the water holding the substance in solution. In the case, for instance, of potassium sulphate in dilute solution the sum of the two quantities of heat is $15.7 + 34.5 = 50.2$ cal. when one gramme of hydrogen is liberated. This is equivalent to 2.20 volts, a number which Le Blanc has obtained by direct observation. Other results are quoted in support of the above law, which the author maintains as an empirical law, independent of any hypothesis regarding the condition of the dissolved salts in solution.

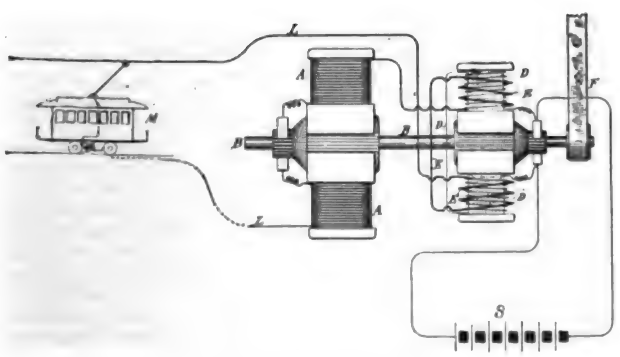
ELECTRIC TRANSPORTATION DEPARTMENT.

CURRIE'S RAILWAY POWER STATION STORAGE BATTERY ARRANGEMENT.

To secure uniformity in engine load in railway power stations the storage battery suggests itself and the results obtained in the few stations so equipped here and abroad leave little room for doubt that this method will come into more general use at no distant day.

The usual practice in stations so equipped has been to connect the storage battery with the main or working circuit to supplement the dynamo, but under ordinary conditions this would necessitate a battery of very considerable voltage, and increases the tendency to leakage, short-circuiting, and injury to the plates. To obviate this and to secure a better regulation than that which is dependent upon fluctuations in the speed, which it is one object of the system to prevent, Mr. S. C. C. Currie drives two mechanically-connected dynamo electric generators, mounting the two armatures on the same shaft, and using one to supply current to the external circuit, and the other to charge storage batteries which are permanently connected up in its circuit.

The arrangement is shown diagramatically in the accompanying engraving. The main generator A which supplies the line has mounted on the same shaft the armature of a second generator C having a compound-wound field, one coil D being in shunt to the armature and of fine wire, while the other coil E is of shorter heavier wire and connected up in the main circuit L L of the generator A, the winding being such that the main current has a tendency to demagnetize the field of the second generator. In the circuit of the second generator is the storage battery S of a



CURRIE'S RAILWAY POWER STATION ARRANGEMENT.

capacity calculated to meet the requirements of practical working.

In illustration of the operation of the system, suppose the power of the prime motor be maintained at about fifty horse-power, while the load on the generator A varies from double this amount to nothing. When the load on the generator A reaches or is in excess of the limit of the engine, the heavier current on the line lowers the electromotive force of the second machine, so that it becomes a motor and is driven by the battery. On the other hand, when the load is light the electromotive force of the second machine rises and it becomes a generator, charging the battery. In practice with due observance of proportions it would be fair to assume that the total power required from the battery to the shaft would not exceed twenty-five per cent. of the total power transmitted from the shaft to the line, so that with a daily output of one thousand horse-power hours not more than two hundred and fifty horse-power hours would be required for the battery.

Such a combination necessarily involves a certain loss, both in charging the battery by the generator and in running the motor by the battery; but allowing for such losses and also the small loss by the neutralization of the field of the second generator, there are still many cases where the total saving from being able to maintain a steady load on the prime motor would much more than compensate for the losses named.

A NEW PHILADELPHIA GAME.

PHILADELPHIA CHILDREN have a new and delightful game called "Trolley Car." It is played by from two to twenty juveniles, all but one of whom sprawl on the pavement, while the other pushes a baby carriage over their prostrate forms.

ELECTRIC TRAMWAYS OF LONDON AND BOSTON.

IN a paper read before the Electro-Technical Society of Cologne, Mr. G. Kapp makes an interesting comparison between the tramway systems of London and of Boston. Though the former city covers about ten times the area of the latter, the length of lines in the two is nearly identical, Boston having about 270 miles of line, and London about 20 miles less. The number of car-miles run in Boston is 18,750,000 miles, and in London about 21,870,000 miles. But though the density of traffic is thus greater in London than in Boston, the latter makes much more satisfactory returns to its shareholders, the averaged dividend there being 9 per cent. on a capital account some 25 per cent. more than in London, where, nevertheless, the shareholders have to be content with but 8¼ per cent. or so, on their capital, which, moreover, from the recent decisions of the courts, appears to have been staked on a very precarious security. The working expenses of the two lines are practically identical, but in Boston they only amount to 68 per cent. of the receipts in place of 82.7 per cent. as in London. The Boston lines are, it should be added, worked on the trolley system, whilst, with the exception of a small proportion of cable line, the London tramways are worked entirely by horse traction. Mr. Kapp states that in Germany there are now some 212 miles of line worked electrically, the rolling stock consisting of 540 motor cars and 420 ordinary ones. An additional 112 miles of line are, moreover, now in course of construction, and will find employment for 290 motor cars. Some of these lines have very heavy grades; in particular, there is one in Barmen where an incline of 1 in 5 is surmounted, a rack rail being used, as the adhesion is, of course, insufficient. Nevertheless, quite steep slopes are worked without calling in the aid of such special devices, there being a slope of 10 per cent. on the Remscheid line. The ratios of expenses to receipts on these lines are put at an extraordinarily low figure, as little as 18.4 per cent. in some cases. In certain of the smaller plants the sudden and great variations in the demand for current have proved troublesome, and have led to the use of accumulators as regulators. At Hirslanden, near Zurich, for instance, the plant includes two 90 horse-power engines, one of which is used as a stand-by. There is also a battery of accumulators, consisting of 800 elements, which in normal work can supply a current of 81 amperes. The current on the line ranges, with the nine cars in use, from 50 to 110 amperes, but occasionally reaches as much as 200 amperes. Automatic apparatus regulates the supply in such a way that the dynamo gives a constant current of 80 amperes, any deficit being made up by the batteries.

WILL MR. PAYNE KINDLY EXPLAIN?

H. R. Payne, of Dunkirk, N. Y., one of the oldest locomotive builders in America, says: "It will be many years yet till electricity supersedes steam on our railways, unless some radical changes can be made. Experiments recently made show that it is possible to work an electric locomotive, but the expense of a few collisions would bankrupt any road."

THE TROLLEY LINES BETWEEN WASHINGTON AND BALTIMORE.

A special dispatch from Baltimore says: The contract for the building of the roadbed of the Columbian & Maryland Electric Railway, which will connect Baltimore and Washington, over a thirty-six mile route, has been awarded to E. D. Smith & Son, of Philadelphia. The cost of construction, including a branch to Ellicott City, will be about $3,000,000. The work will begin at once, and is to be completed within a year.

A contract for a second electric road between Washington and Baltimore is expected to be signed at once in New York. The enterprise is backed by the Washington, Sandy Springs and Baltimore Electric R. R. Company. Allston Gerry and Nathan G. Miller, of New York, and James B. Colegrove and George S. Chase, of Washington, have agreed to take an issue of $750,000 of thirty-year 5 per cent. gold bonds, the proceeds of which are to be employed in building the line. The capital stock of the company is $1,500,000.

In planning the Sandy Springs route no attention has been given to the possibilities of through business between Washington and Baltimore, but the aim has been to traverse a developing section not now reached by railroads. The Columbian and Maryland Line, on the other hand, has been surveyed with a view of running express trains between the two cities over the shortest possible route in competition with the Pennsylvania and Baltimore & Ohio Railroads.

FENDERS ORDERED ON ALL MASSACHUSETTS STREET CARS.

The railroad commissioners of Massachusetts have issued an important circular, which affects every street railway in the state. Under an act passed by last year's legislature the commissioners gave a number of hearings to persons interested in railways and others relative to equipping street cars with fenders which would be capable of saving life.

The result of these hearings and investigations by the railroad commissioners is the order sent out to every street railroad in the state. The roads have until Nov. 14, 1895, to comply with the order, which is as follows:

"Ordered, That the following requirements and regulations be prescribed and notified to the several companies relative to the subject matter of the aforesaid act:

"Regulations for the equipment of street railway cars with fenders and wheel guards.

"1. All cars run by a street railway company on a highway, town way or traveled place (excepting cars run by horse power, cars run only as trailing cars, and, until the further order of the board, cars run wholly within the limits of towns whose population is less than 7,500 each), shall be equipped with fenders and wheel guards in accordance with one of the two following methods: Either (1) with a fender at the front of the car (going in either direction), and also with wheel guards underneath the car; or (2) with a fender at the front of the car of such design as to serve also as a wheel guard.

"In the first case (1) the fender shall consist of a platform, netting, or other similar device, constructed and arranged so as with reasonable certainty to pick up a person who is run into while standing, but to pass over a person who is lying on the ground, without probable injury to the person in either contingency; and the wheel guards shall be of such construction and arrangement or method of operation as to prevent, so far as practicable, a person who has fallen or been thrown down from being run over by the wheels.

"In the second case (2) the fender shall be of such construction, arrangement and method of operation as not only to pick up as aforesaid a person who is run into while standing, but also to prevent as far as practicable a person who has fallen or been thrown down from getting under the car and being run over by the wheels. This form of fender shall accordingly include a device by which, in case of emergency, it can be lowered by the motorman, and when lowered held down close to the ground.

"2. These regulations shall take effect on the 14th day of November, 1895, and may be modified from time to time, in general or in particular, as experience and the public safety may seem to the board to require.

"Note—There are, it is well known, many kinds or forms of fenders and wheel guards. It can, perhaps, hardly be expected that any of them will afford absolute protection under all circumstances. Some of them have shown or promise reasonably good results, but no one fender or wheel guard has as yet been proved to be so unquestionably superior to all others, tried and untried, as to justify the prescription of its sole and exclusive use.

"Under these circumstances it has seemed to the board, in the performance of the extremely perplexing task imposed upon it by the statute above cited, to be wiser and better to define the methods of protection, and point out the essential features or requisites of the appliances which must be adopted than to prescribe the use of any particular invention or device. There are obvious reasons why the companies should not be compelled to deal with a single patentee. It is, moreover, desirable that different types, within the lines prescribed, be tested by actual use. Only in this way will the best device be found out.

"It is expected, therefore, that the several street railway companies, in the exercise of a careful judgment, in good faith toward the public, and upon their own legal responsibility under the statute, will select and apply to their cars such fenders and wheel guards as come within and satisfy the requirements of the above regulations."

HE THINKS FENDERS OF LITTLE SERVICE.

At the meeting of the New York Assembly special committee of railroad investigation on August 7, in Brooklyn, John Steiner, a railroad man for thirty-four years, twenty-nine of which have been spent in the service of the Brooklyn and Newtown company, testified that he was a motorman and could stop a car running at the rate of ten miles an hour in fifteen or sixteen feet, and a car running at six miles an hour in from six to ten feet. He considered vestibule cars bad for crowded cities, because they are so constructed as to obscure the view of the operator, especially if the weather be cloudy. Again they prevent a motorman from hearing sounds on either side of him, which is of importance if the car is to be run with the greatest safety. Asked as to what form of fender he most favored, Mr. Steiner said he was against all fenders, believing none of them to be of any account. The best fender, he added, was a level headed motorman. In all the years he has been operating cars he has never had an accident.

ANOTHER "PENNSY" TROLLEY BRANCH.

A special dispatch from Mt. Holly, N. J., of Aug. 2 says:—That Medford is to be connected with Mt. Holly by trolley there is no longer any doubt. A reporter caught a hint yesterday that the railroad company was getting ready to wire the road between Mt. Holly and Medford, and a close investigation confirmed the rumor. The same crew that wired the Burlington road will do the work, and the material is now being prepared. The indications are that the work will be under way within ten days.

The company is delighted with the results of the Burlington experiment and, it is said, has in contemplation the question of a trolley to Vincentown. As the power plant has already been built for the one road, it would, of course, be a matter of economy to operate the three roads. The Burlington road carried nearly eleven hundred passengers on Sunday and has done a wonderful business daily since it started. The company is having several other cars made and will not only give Medford and Lumberton a good service, but will increase the Burlington service if the travel demands.

THE TROLLEY IN BINGHAMTON, N. Y.

The Binghamton Railroad Company, organized under the laws of the State of New York, is the outgrowth of the consolidation of all the street railroads of this city. Since the last annual report, issued July 1st, 1894, the road has shown the remarkable gain in gross earnings of seventeen per cent., and a gain in net earnings from operation, including taxes, of twenty-three per cent. The percentage of operating expenses to earnings for the past year was 57⅝ %. These results have been accomplished with the same trackage, under the same conditions and in the face of the prevailing financial depression and the most severe winter the road ever experienced. After paying interest on funded debt amounting to $31,500, there remains a dividend upon the capital stock of over five per cent. G. T. Rogers is president of the road; C. O. Root, secretary; J. B. Rogers, treasurer and J. P. E. Clark, general manager.

STEAM RAILROAD MRS. PARTINGTONS.

A new political organization has been formed in Jersey City, composed entirely of the employees of the various steam railroads whose eastern terminals are in this county. It is claimed that all of them are represented in the movement. The members say they were compelled to organize to protect themselves from trolley roads, whose great increase of late is likely to reduce the wages of railroad men by reducing the volume of steam railroad business. The resolutions adopted pledge the association to support no candidate who will not pledge himself to oppose any legislation in favor of electric roads. The members say they took an active part in the election in Hudson County last year, and that all the successful candidates were indorsed by them. Four were Democrats, and eight were Republicans.

A LARGE ELECTRIC ELEVATOR FOR TAMPA, FLA.

A special dispatch from Tampa says: The foundation for the electric elevator at Port Tampa is being driven and prepared, and the machinery has begun to arrive. D. W. Shea, the electrician of the Plant System, who suggested this method of operation as superior to the use of steam, has just returned from Pittsburg, where he has been to witness the testing of the apparatus, which was in every respect highly satisfactory. The capacity of this elevator will be 240 tons or twelve cars per hour; it will require 100 horse power to operate it, which will be supplied by alternating current from the electric light station at Port Tampa City, 10,000 feet away, where they are now making the necessary arrangements for placing the generator and switchboard. The erection of the machinery will be begun in a week or ten days and the elevator will be ready October 1. The old steam elevator will also be run by electricity. After figuring out all the details and allowing a margin for unforeseen contingencies it is estimated that the saving in expense will be 25 per cent. To the shipper it will be a great advantage, for it will greatly expedite the loading, and thus lower freight rates.

"A GOOD THING—PUSH IT ALONG."

Mr. H. Bottomley of the Marlborough, Mass., Electric Co. writes: Your "Data Sheets" idea is a good thing—push it along. For ten years I have collected data of all kinds; and now, when I want to refer to it I am obliged to look over several imperfectly catalogued books, and it's "dollars to doughnuts" that I cannot find what I want without much labor and time. Like Micawber, I have waited patiently for "something to turn up" in the same line that is better than mine, and now, like Oliver Twist, I call for "more." Please send me a morocco filing case.

TELEPHONY.

MEETING OF THE EASTERN TELEPHONE PROTECTIVE ASSOCIATION.

THE second meeting of the Eastern Telephone Protective Association was held in the Postal Telegraph Building, New York, on August 15, though the organization was not completed at that time owing to the absence of some of the proposed members. Another meeting will be held on Aug. 20 to ratify all actions already taken and to come to some definite arrangements as to the appointment of counsel to defend all suits brought by the American Bell Telephone Co. against any alleged infringers of the Berliner patent.

LIKES THE TRANSMITTER SET FORWARD.

"There is one thing about the new telephones," remarked a gentleman who has occasion to use that instrument a great deal, "that I like very much, and that is the change made in the transmitter. Formerly the transmitter was set back toward the box proper of the instrument and to speak into it a person had to put himself in a strained position that was very disagreeable as well as tiresome, and even then the voice could not be heard any too distinctly. But in the new pattern the transmitter is set on blocks which throw it several inches from the box of the instrument and obviate the former disagreeable features."

RUMORS AS TO AMERICAN BELL.

THE *Beacon*, of Boston, says on alleged good authority that the American Bell Telephone Co. will remove to some other state because of the restrictions placed upon the company in the matter of increasing its capital. The failure of the large stockholders to subscribe for the new stock recently offered them is said to be due to their knowledge of the fact that the officials of the company are discussing the advisibility of taking out a charter in a state where the hostility to corporations is less pronounced than in Massachusetts. In commenting further upon the enforced auction sale of about 6,500 shares of the new stock, the *Beacon* says: "The disposal of so large a block of stock by auction, however beneficial it may be to the community at large, as compared with the old method of issues of rights to stockholders to subscribe at par, is in one way unjust to the smaller holders of the stock. Thus, no one at auction can buy less than 50 shares. And yet the auction is in the very nature of the case likely to create lower prices for the stock than those prevailing in the open market, either before or after the sale. A plum thereby is offered to the heavy purchasers, who are in a position to make a handsome turn by grabbing the auction stock and then manipulating the market to a higher level and selling to their less wealthy fellow-stockholders."

TELEPHONE NOTES.

BANGOR, ME.—The Dirigo Telephone Company has obtained a license to construct a system in Bangor.

BALTIMORE, MD.—Mr. Fred B. Hubbell, of Baltimore, has been elected president of the Home Telephone Company in place of Mr. Franklin Noble, of New York.

TRENTON, N. J.—The new telephone company has enrolled some 400 subscribers in its scheme to supply a cheaper telephone service in this and adjoining states. It is proposed to begin in this city when 500 names have pledged themselves to the new undertaking.

LACONIA, N. H.—Telephone communication between Laconia and Centre Sandwich has been completed. The distance is twenty-four miles. Offices have been located at Centre Harbor, Moultonborough, Lower and Center Sandwich.

WATERVILLE, ME.—The New England Telephone and Telegraph Company has just completed a metallic circuit from Waterville to Pittsfield. A new copper metallic circuit has also been connected between Waterville and Brunswick, which now makes a continuous copper metallic circuit from Pittsfield to Portland.

LITTLETON, N. H.—Telephone men are improving the lines in this vicinity. New poles are being set over most of the line between Woodsville and Lancaster, to carry a copper wire. With the completion of the metallic circuit to White River Junction, this section will have long-distance connection with all parts of the country.

WATERTOWN, N. Y.—The Watertown Telephone Exchange Company has been incorporated to maintain lines connecting Watertown and towns and villages of Jefferson county, with a capital of $50,000 and directors, A. L. McCrea, Jr., and J. M. McIntyre, of Gouverneur; John C. Streeter, Samuel Felt, George C. McMullin, James L. Newton and Francis A. Sherman, of Watertown.

BOWLING GREEN, KY.—The line to Glasgow has been completed.

NAUVOO, PA.—The new telephone line is in operation from Nauvoo to Wellsboro, Tioga county.

VICKSBURG, MICH.—The Southern Michigan Telephone Company has opened its local exchange here for business.

PAWTUCKET, R. I.—The work on the conduits of the Providence Telephone Co. is going on rapidly and the conduits already built have been connected.

PAUL'S VALLEY, TEX.—A contract has been made with Grant & Co. for a telephone line from Paul's Valley to McGee and Center, thirty miles distant, using the National telephone.

COLLINS, MO.—A telephone line has just been completed connecting this place with Osceola, which will give connection with Osceola, Loury and Appleton City line.

LATROBE, PA.—The Telephone Exchange Company, of Latrobe, Westmoreland County, has been formed; capital, $5,000. Joseph E. Barnett, of Latrobe, is president of the latter.

SAVANNAH, GA.—The Bell Telephone Company in Savannah will lay about two miles of conduits and put part of their wires underground.

HAVERHILL, MASS.—The Common Council has voted to postpone indefinitely action on the ordinance to put the telephone wires underground.

CORNING, N. Y.—A project is on foot to erect a telephone line from Corning to Hornby Forks. It has been suggested that the citizens of Hornby build the line and take half the receipts. It will cost from $100 to $125 per mile for poles and wire.

INDIANAPOLIS, IND.—An ordinance has been prepared which will put all wires running through the city in the mile limit underground. This will include telegraph, telephone and electric light wires.

PETERSBURG, VA.—The Southern Bell Telephone Company has notified its subscribers in Petersburg that the price of telephones for stores would be reduced to $18 per annum and those of residences to $10 per annum.

RHINEBECK, N. Y.—The Hudson River Telephone company, through their representative Mr. H. C. Mackey, have secured enough subscribers to practically insure the establishing of a local exchange.

WHITEHALL, N. Y.—Since the Hudson River Telephone Company decided to extend the long distance service to Whitehall and Rutland, a plan is on foot to build a new line from Whitehall to Montreal.

CUMMINGS, N. D.—The Northwestern Telephone Co. now have a large crew of men setting poles from Cummings to Mayville. They expect to have the line in operation by the middle of August.

LEAVENWORTH, KAS.—At a meeting of the police commissioners an agreement was made with the People's Telephone Company to place eight or twelve telephone alarm boxes in various parts of town for the convenience of the police patrol.

SOUTH BEND, IND.—The South Bend telephone company has been formed. Capital stock, $50,000. Directors, C. B. Van Pelt, Louis Nickel, jr., W. H. Longley, E. G. Waldron, W. L. Kizer and F. W. Martin.

THE HOME TELEPHONE CO., of Mobile, Ala., Paul Minnis, general manager, are now rapidly installing a telephone exchange to be ready early in September. The switchboard for 600 subscribers, will be furnished by the National Telephone Mfg. Co., of Boston.

DETROIT, MICH.—Mayor Pingree has approved the Harrison Telephone Company's franchise, making it a law and has vetoed the Brown Loud Speaking Telephone Company's ordinance, rendering it valueless, unless twenty-two aldermen pass it over his veto.

LANSDOWNE, PA.—The Delaware County Telephone Company is the name of a local telephone company being organized to operate at Lansdowne and vicinity. The object is to give cheaper service and direct connection to Philadelphia and points on the long distance wire. The rates will be $2.50 per month for stores and $1.50 per month for private dwellings.

RICHMOND, VA.—There is a big telephone fight on in Richmond. There are now two new companies soliciting subscribers with a view to asking the Council for franchises. One is the Standard Company, and the other the Home, of Baltimore, which was chartered under the laws of West Virginia. Both offer business telephones at $3 per month and residence service at $2 per month. The present Bell Company charges $64 for business and $40 for residence phones.

BLOOMER, WIS.—The wires and electric appliances for a new telephone exchange at Bloomer have arrived.

NASHVILLE, TENN.—A new telephone company is being formed and it is said 1,200 subscribers have been secured.

BRATTLEBORO, VT.—The Brattleboro telephone exchange has 206 subscribers and a new switchboard has been ordered.

SHELDON, MO.—Sheldon will soon become connected with Nevada by telephone line. The line will be built by subscription, Sheldon having subscribed $375.

SIOUX CITY, IA.—The Home Telephone company is putting in two new sections of its switchboard, and will have 500 telephones connected up this week.

RED HOOK, N. Y.—A telephone company has been formed at Red Hook, whose intention is to connect that place with Barrytown, Barrytown Corners, Cedar Hill, Annandale and Madalin.

NEW HAVEN, CONN.—The Southern New England Telephone Co. has made an arrangement with the state whereby the line to Camp Coffin will be rebuilt.

COLUMBUS, MISS.—The Citizens' Long Distance Telephone and Telegraph Co.'s plant is rapidly nearing completion, and it is expected that within one month the exchange will be established and the entire system in operation.

OSKALOOSA, IA.—Manager H. W. Comstock, of the old telephone company, is in receipt of advices to the effect that the company will soon begin the work of putting in the "return system" of wiring for the Oskaloosa exchange.

CATLETTSBURG, KY.—The stockholders of the Catlettsburg telephone line held a meeting the other day, and decided upon the placing of a telephone line up the river connecting with the new Huntington company's service which will be extended to Ceredo.

CHILLICOTHE, O.—The Home Telephone Co. of Chillicothe, Ohio, has recently constructed a new telephone exchange and lines in that city, in opposition to the old company, and with rentals at $1.50 for residences and $2 for business houses, has over three hundred subscribers under five years contract.

COLUMBIA, S. C.—A commission for a charter has been issued to the Columbia Telephone Company of South Carolina. The corporators named are: W. Y. Abraham, W. B. Lowrance, F. D. Kendall, A. R. Stewart, R. J. Johnson, T. J. Harper and J. B. Friday. The capital stock of the company is to be $5,000, and the right to increase it to $50,000 is given.

LANSING, MICH.—The Lansing telephone exchange is a body corporate. It became so with the filing of its articles of incorporation and the election of its officers. Jacob Stahl was elected president of the new company and D. A. Reynolds manager. The capital stock of the company is $30,000 of which $20,000 is paid in.

KINGSTON, N. Y.—The battle between the Bell telephone monopoly and the new Standard Telephone Company is about to begin here. The Hudson River Telephone Company, the local branch of the Bell system, was charging $72 a year, and tolls on all messages outside the city until within a few weeks. Now it has reduced rentals to $25 a year, but retains the tolls.

SPRINGFIELD, ILL.—A bill has been introduced in the House of Representatives to regulate telephone companies in Illinois. It fixes the maximum rates as follows: In cities of 1,000,000 or more inhabitants, $78 per annum; in cities of more than 500,000 and fewer than 1,000,000 inhabitants, $66; in cities of more than 100,000 and fewer than 500,000, $48; in cities of fewer than 100,000, $36.

ELIZABETH, N. J.—The City Council has granted the Elizabeth Mutual Telephone Company a franchise to operate a telephone system throughout the city. An injunction was placed on the company by the New York and New Jersey Telephone Company recently, which was dissolved when the former company reorganized. The new company will at once commence the erection of poles, etc. The capital stock is $30,000.

FALL RIVER, MASS.—The work of putting the telephone wires underground has begun. It is being done by the National Conduit and Construction Company of New York City. The total length of ducts is 55,095 feet; total length of trench 7,975 feet. The latter will be from 4 feet to 10 feet deep according to the number of wires required to be buried. In width the trenches will vary from 2½ to 4 feet.

KINGSTON, N. Y.—An arrangement has lately been entered into between the officers of the West Shore Company and representatives of the Standard Telephone Company, under which the plant of the former company will become the property of one of the branches of the latter and the lines of the West Shore will be completed and put in operation throughout the entire territory covered by that organization.

MOBILE, ALA.—The use of the telephone system in connection with the patrol boxes has been strongly recommended.

DETROIT, MICH.—The Harrison Telephone Co. has accepted the franchise granted by the city.

GREENSBURG, IND.—The Greensburg Telephone Company has built entirely new the line between Milroy and Richland. This line was first built some six years ago.

NEWBERNE, N. C.—A telephone exchange is to be erected here. The whole equipment will be manufactured at Fayetteville, it is said.

DOUGLAS, MICH.—A telephone company has been organized at Douglas to connect Douglas, Saugatuck and Ganges with the outer world.

CHAMPAIGN, ILL—The Phœnix Telephone Company of Champaign has been making very rapid progress in the erection of poles and stringing of wires.

WESTERLY, R. I.—The Rhode Island Granite Works has been granted permission to erect telephone poles along Oak and Tower streets to its Red Quarry.

ANDERSON, IND.—J. M. Overshiner & Sons have entered extensively into the telephone business. They purchased the telephone at Elwood from the Pana Telephone Company and are also constructing an exchange at Logansport.

SANDUSKY, O.—The ordinance which grants to the Sandusky Telephone company rights to put up poles and string wires through the streets of Sandusky was passed at the regular meeting of the city council.

CLEBURNE, TEX.—A telephone company has been organized. Nearly all the stockholders are Cleburne men. The National Telephone Company of Boston is the promoter. The plant will be put in at once.

APPLETON, WIS.—F. L. Humes, of the National Telephone Co., has petitioned the council for permit to come into the city. This company will soon have an exchange in operation at Waukesha and at once go to work building one at Fond du Lac.

DRISCOLL, TEX.—The telephone line is now completed to Alice. The stockholders have elected the following officers and directors: L. K. Foster, president; G. W. Newberry, vice president; N. H. Brown, secretary and treasurer; John Wade, T. C. Wright and George Hobbs, directors.

TORONTO, O.—The city council has passed an ordinance granting franchise to the Phoenix Telephone Company of Steubenville to erect and maintain lines in this city. This company will embrace Steubenville, Toronto, Wellsville and Liverpool, north; Mingo and Brilliant, south; Richmond and Wintersville, west.

WEST BOYLSTON, MASS.—The New England Telephone company is about to build a house on the line of the Central Massachusetts railroad near the Clarendon Mills at West Boylston, for long-distance telephones in anticipation of use by the Metropolitan officials.

INDIAN FIELDS, N. Y.—The stockholders of the Coeymans and Westerlo Telephone Company have elected the following officers: President, G. C. Lamoreau; vice-president, A. D. Briggs; secretary, Lindsey Green; treasurer, Stephen Tompkins; directors, G. C. Lamoreau, Will Cole, Jr., Vincent Snider, J. M. Nodine, B. T. Briggs, A. D. Briggs, Lindsey Green, W. Caswell, H. S. Hempstead, H. N. Johnson, M. S. Reid and J. W. Cowen.

COLUMBUS, IND.—The Citizens' Telephone Company (the Harrison system) has completed and opened its large exchange in Columbus and has reduced the rate of the Central Union from $36 to $27 per annum for business houses, and from $36 to $18 for residences. The last named company now announces an open rate of $12 for business houses and $8 for residences. The country line of the Harrison system has been completed to Clifford, St Louis Crossing, Hope, Nortonburg, and Flatrock.

IOWA FALLS, IA.—The Western Telephone Company is a new competitor in that line in this state and Minnesota and promises to become one of the leading organizations of this class in the west. The officers of the company are: J. F. Case, Sumner, Ia., president; C. Webster, Waucoma, vice-president; T. H. Potter, Corwith, secretary; T. H. Way of Britt, treasurer. It is the intention of the company to push north as far as Minneapolis and St. Paul, and as far east as Chicago.

BALTIMORE, MD.—At a meeting of the directors of the Standard Telephone Company, which proposes to establish a new telephone system in Baltimore, it was decided to contract with a New York construction company for the building of its line. Officers were elected as follows: President, John N. Woodland; vice-president and general manager, George W. Cross; secretary, Bruce B. Gootee, and treasurer, Elbridge S. Johnson. It was stated that the contract is about closed for building the long distance line between Baltimore and Washington.

THE CHOICE OF TRANSFORMERS.[1]

BY PROF. D. C. JACKSON.

In order to place before you independent data representing all the American transformers of moderate capacities I will give the results of a long and carefully carried out series of tests made by Mr. A. H. Ford in the laboratory of the University of Wisconsin. For these tests transformers of fifteen hundred watts capacity, as nearly as possible, were procured directly from the manufacturers within about a year from this date, so that the tests may be presumed to represent the latest and best designs which are now supplied. These transformers are from the most prominent makers and in fact include all important makes of American transformers with two or three exceptions. The results of the tests are given in the attached table. (Table I.) These results, I find, do not differ very widely from those published by the Fort Wayne Electric Corporation in a small blue printed pamphlet, which however, contains tests made by the company upon only a few of the makes of transformers included in my table.

TABLE I.

No.	Watts capacity.	Open circuit current. F=125	Open circuit current. F=60	Watts Iron loss. F=125	Watts Iron loss. F=60	Watts Copper loss full load.	Total drop.	Efficiencies full load. F=125	Efficiencies full load. F=60	All day. F=125	All day. F=60
1	1250	.043	.066	37	48	30	2.5	96%	94%	85%	83%
2	1500	.076	.124	50	71	45	3 5	95	94	85	81
3	1500	.053	.100	32	46	33	4 0	96	95	89	85
4	2500	.230	.540	185	290	44	2 5	92	89	77	68
5	1800	.075	.600	58	109	67	5.0	94	92	85	75
6	2000	.055	.091	42	56	55	5.0	95	94	89	86
7	1000	.028	.064	24	28	33	3.0	95	94	87	86
8	1500	.073	.113	57	76	31	2.5	94	93	83	79
9	1500	.077	.144	43	55	28	3.0	95	95	86	84

The data for each transformer is given for tests upon two frequencies,—125 and 60 periods per second, respectively. Efficiencies have been calculated and are given in the table for each transformer when operated upon each frequency continuously at full load and also when operated at an assumed load which may be taken as an approximation to the average load found on good stations operating twenty-four hours. The latter are called "all day" efficiencies and are calculated as though the transformers ran nineteen hours out of the twenty-four on no load and five hours on full load.

A comparison of the losses of the different transformers and the efficiencies shows in most cases that the transformers with the smallest iron losses give the highest "all day" efficiencies. The effect of the iron loss on the working efficiency depends upon the length of time the plant runs. The waste of power due to the iron loss in the transformer continues as long as current is fed to the primary circuit, consequently a plant which only runs six hours per day will only waste one quarter of the power by the iron loss of its transformer, that it would if operated twenty-four hours per day. The actual number of watt hours used by the customers of the plant might not differ very greatly in the two cases, yet the out-put of the station when run twenty-four hours might be much greater than when run six; the former difference being due to the difference in the amount of power wasted in the transformers. It is therefore evident that extreme care in the selection of the best transformers to be used on an alternating plant which runs all day may be of the greatest advantage. The lower the frequency of the alternating current which is used, the greater are the returns coming from this care likely to be.

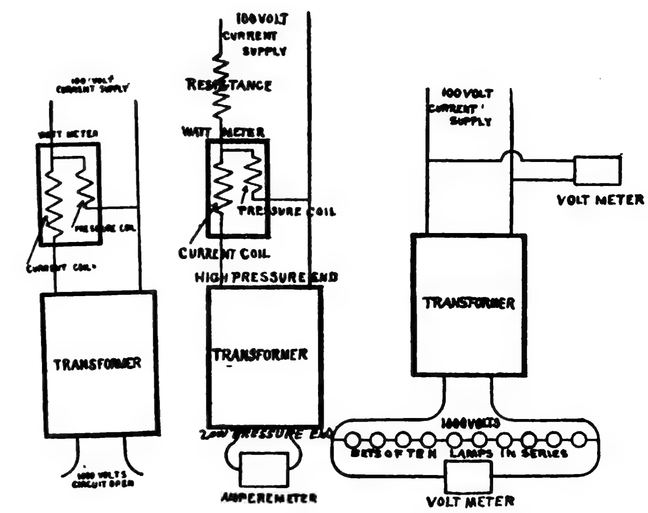
The advantage to be derived by testing every transformer before placing it on the line.—Let us compare transformers Nos. 3 and 4 as given in the table. These are both made by well-known manufacturers. The copper losses at full load do not differ very much, what difference there is being in favor of No. 4. At average loads there would be considerably less difference in these two points. The iron losses, which go on regardless of the load as long as current flows in the primary winding, differ very greatly even if we take three-fifths of the loss in No. 4 as the losses of a 1500 watt transformer of that type. Let us suppose that these transformers are placed on a plant which supplies current twenty-four hours each week day and twelve hours on Sunday, which makes a total of 8,136 hours per year that current would flow in the primary winding of the transformers, and the total number of watt hours wasted by the two transformers is shown below :—

	F. = 125.	F = 60.
Transformer No. 3,	8136 x 32 = 262,000.	8136 x 46 = 374,300.
Transformer No. 4,	8136 x 80 = 651,000.	8136 x 140 = 1,140,000.

In a station which turns out a kilowatt hour for each eight pounds of coal burned (and this in Wisconsin requires the station to be well arranged and the use of coal that costs two dollars and a half or more) transformer No. 4 requires the buying of about a ton and a half of extra coal every year when operated at a frequency of 125; therefore it costs, other things being equal, upwards of four dollars per year more to operate than number three. It would therefore pay well if other things were equal, to buy transformer No. 3, even if its first cost were many dollars greater than that of No. 11. The difference between the transformers is even greater when the frequency is 60.

For every hundred transformers of the types here compared, the generator plant that supplies current to No. 4 must be of 5 kilowatts greater capacity than that required for No. 3, which means an increase of three per cent. in the generating plant; that is, a plant of a given size which has transformers No. 4 must have a capacity for supplying current greater by three per cent., than if transformer No. 3 were used.

Differences sometimes occur between transformers of the same size and same make which are not as great as the differences here shown to exist between numbers three and four, but are sufficiently great to seriously affect their economy. In order to husband the capacity of a plant and to save in operating expenses, it is therefore of importance not only to test transformers of different makes which are presented for sale, but to test each transformer which is put on the line. This may be easily and expeditiously done. To test the iron losses the secondary coil of a transformer should be connected to the regular lighting circuits with an ordinary wattmeter included, and the circuit of the primary coil should be left open ; the arrangement is plainly shown in Fig. 1. The reading of the wattmeter shows the number of watts which are wasted by the iron loss. If the regular wattmeter is too expensive to buy, an ordinary Thomson recording wattmeter, provided a sufficiently sensitive and reliable one



FIGS. 1, 2 AND 3.

is at hand, may be used in place of it, and the record reduced to the basis of one hour. It is needless to say that instruments which are used in such tests as are here proposed, must be fairly reliable.

To test the copper losses in a transformer the quickest and easiest method, which is approximately accurate, is to connect the primary coil of the transformer in series with some resistance (iron wire or lamps) to the alternating incandescent circuit, and short circuit the secondary coil of the transformer through an amperemeter. (Fig. 2.) The resistance should be adjusted until the full load current of the transformer flows through the amperemeter. The reading of a wattmeter so connected in circuit with the primary coil gives the copper loss approximately.

The drop in pressure in a transformer may be measured by connecting the transformer to the lighting circuits and reading the primary and secondary pressures by voltmeter (Fig. 3). The transformer may then be loaded by lamps and the pressure again read, when the drop is at once seen. One voltmeter may be used for this, but two are more convenient.

For your guidance in selecting transformers, I will give you the following data, contained in a table made out by Professor Ryan. The table gives the largest currents which should flow in the 1,000 volt primary of good transformers when the secondary circuits are open.

Watts capacity.	*Leakage current.*
1000	.055
2000	.080
6500	.100
17500	.200

When the low pressure coil is connected to a hundred volt circuit the leakage currents may be expected to be ten times as great.

For intermediate capacities, intermediate values of the open circuit or leakage current may be expected. I will add to this

1. Abstract of a paper read before the Northwestern Electric Association.

the values of the iron loss which should not be exceeded in thoroughly good transformers.

Watts capacity.	*Iron loss.*
1000	30
1500	40
2000	50
2500	60
4000	80
6500	100
17500	150

The copper losses in transformers of all sizes should never exceed 3½ per cent. at full load, and ought to be between 1½ and 2½ per cent. The total drop in secondary pressure due to loading a transformer, if the primary pressure is kept constant, ought not to exceed 3½ per cent.

ALTERNATING VS. CONTINUOUS CURRENT DISTRIBUTION AT NIAGARA FALLS.

THE work at Niagara has given rise to several controversies and it seems there are still points on which there is a difference of opinion among those who were consulted in the early stages and in the carrying through of the work. Recent issues of the London *Times* contain a number of letters of a highly interesting character bearing on the history of the adoption of the alternating current at Niagara, which, in view of the importance of the subject and the eminence of the parties in controversy, we print below in full:

YOUR New York Correspondent lately announced the successful commercial delivery of electric current from the great 50,000-horse power generating station at Niagara Falls to the first consumers, who use it for making aluminum. I also have received reports of the thorough success of the practical working, and it will be interesting to many of your readers to know wherein the novelty of the work consists, and the value of the results to the whole world.

When I designed the 5,000-horse power dynamos the largest in existence were of 1,500-horse power. The transformers which we employ, as well as other machinery, are also of far greater magnitude than any previously made, and this is part of the reason why the cost of these works is far below what any other engineer has been able to approach. There was nothing experimental in going to these large sizes; the nearest approach to experimental work was when I settled upon the machines for converting alternating into continuous current for the aluminum works, and these have now justified my choice. Such machines on a small scale were shown by Schuckert at the Frankfort Exhibition of 1891; but I took upon myself a great responsibility when making the first commercial use of them on so great a scale—four machines, each of 150 volts and 2,000 amperes. I selected as manufacturers the General Electric Company of America, and they deserve the greatest credit for the result. This Company has also made some novel and excellent machinery which enables us to supply electrical energy at variable pressure to the 1,000-horse power electric furnaces of the Carborundum Company. I will not refer to matters which I had to arrange for, but which are not yet completed. These include transmission of electrical energy to Buffalo and its distribution; also the machinery for adapting the current for arc lights, for incandescent lights, for electric tramways, and for factories and mills. I mention these only to show the variety of requirements which had to be met, with strict attention to cost. Any customer may now ask either for continuous or alternating current at any fixed electrical pressure, or even at variable pressure. My solution of the problem lay in (1) the selection of alternating currents, and (2) the reduction of speed of alternations as low as was possible, and (3) additional safety was insured by my refusal to allow live circuits to be suddenly opened or closed. If this last policy be not continued the directors will have themselves to blame for trouble which must arise.

At the time when I decided upon alternating currents (which had not then been practically used for power purposes), many predicted failure, and some (including my friend Lord Kelvin) have continued to do so. Again, when I adopted low frequency, it was so generally condemned that I claim some foresight in having recognized its merits. I predicted low cost, high efficiency, and increased safety as the results of low frequency, and in practice I have been altogether confirmed. The price charged (with handsome profit) is half a farthing per Board of Trade unit, for which English companies (under more difficult conditions, it is true) are charging about 6 d., and from the time of the inception of this gigantic and novel plant until its commercial working at the present time there has not been a single hitch or mistake to correct.

The Niagara Company make a greater profit by not going to great distances, as it costs them less to supply it near at hand. There is no difficulty or experiment in going to great distances; it is merely a question of expense and of the value of power at the place to which it is transmitted. There are plenty of places in the world where it will pay well to carry electrical energy 400 or 500 miles. I have no hesitation in saying that the low cost and perfect success, practically and commercially, of the Niagara Works opens a new era in the world's industrial evolution.

GEORGE FORBES.

LONDON, July 25, 1895.

A letter by Mr. George Forbes in your yesterday's issue contains the following statement:—

"At the time when I decided on alternating currents (which had not then been practically used for power purposes) many predicted failure, and some (including my friend Lord Kelvin) have continued to do so."

This is not correct so far as the inclusion of my name is concerned. It is true that I advised the directors not to adopt the method of alternate currents; and the correctness of my advice is now illustrated by the fact that in the first practical use of the power it has been necessary to transform from alternate current to continuous current for the electrolytic smelting of aluminum.

In giving my advice to the directors I told them that they could certainly succeed with alternate current, but much better with continuous current.

KELVIN.

AIX-LES-BAINS, July 28, 1895.

IF Lord Kelvin were at home, with his documents to refer to, he would not have written the letter published in the *Times* to-day. On looking through his press copy-book he will nowhere find that he "told them" (the Niagara directors) "that they could certainly succeed with alternate current." On the contrary, he will find copy of a cablegram, in the summer of 1892, to these directors, declaring my policy of using alternating currents to be a fatal mistake or a disastrous mistake. He will also find the same view supported in a lengthy letter which he wrote at the same date. He will also find that in his letter of November, 1894, he referred to this attempt to save them from disaster. Besides these specific occasions on which he volunteered this advice he took further action in the same direction at various times. This was embarrassing to the officers of the company, and they did not disregard the advice of an authority so eminent without finding sound reasons to justify their conduct, which I need not mention here.

As to Lord Kelvin's suggestion, in the letter published to-day, that it would have been better to distribute to all customers the current required by the Aluminum Company (150 volt, continous current), I can at present only state that it is impracticable, and ask, "how about the 110 volts required for incandescent lighting, the 500 volts required for tramways, the 2,000 volts for arc lights, the 10,000 volts required for transmission to Buffalo, the alternating current required by the carborundum electric furnaces, and so forth?" Nearly every one will now admit that the alternating current alone solves the problem well and economically.

GEORGE FORBES.

LONDON, July 30, 1895.

IN your issues of Saturday, yesterday, and to-day appear letters from Professor George Forbes and Lord Kelvin concerning the adoption of the alternating current for the electric power installation at Niagara, and referring to the advice given by them to the directors of the Cataract Construction Company, which did the work.

As first vice-president of that company, which sought and gladly received the advice of these two eminent engineers, I feel it due to both of them that the facts should be stated briefly as follows:

1. In January, 1891, Lord Kelvin was chairman, and Professor Forbes the submitter of a project, to the International Niagara Commission. At the close of that commission every one condemned and rejected the alternating system, excepting only Professor Forbes and Messrs. Ganz and Co., of Budapest.

2. In January, 1894, the Niagara directors had adopted the alternating system upon the advice of Professor Forbes, and with the concurrence of all the expert advisers, including those who had rejected the alternating system in 1891, excepting only Lord Kelvin.

Lord Kelvin thereupon sent to us a cable, in which he certainly indicated a strong preference for the continuous current, but intended also (as we are now gratified to learn from him) as recognizing that we "could certainly succeed with the alternate current."

3. Our decision was thus made because of the prohibitive cost of the continuous current installation, which in most particulars fully justified the strong preference for it evinced by Lord Kelvin, whose eminent and valuable advice and encouragement we gratefully acknowledge. Except for his early and original support, our plan would have died "a-borning," and we thank him for his continuing interest.

4. But the development of our plan must have been long delayed had it not been for the courage and comprehensive knowledge of Professor Forbes, who alone stood for the absolute

commercial advantage of the alternating current, and for his admirable conception of his 5,000-horse power dynamo, so wonderfully worked out by the Westinghouse Company as to yield 5,315-horse power in the actual test on June 28, 1895.

Professor Forbes is entitled to the credit, as he must bear the responsibility, of the results of the advice given by him as to the three points stated in his letter of July 25: and we have followed his advice, perhaps not as far as his courage would carry him, yet beyond the former practice of the manufacturers, who now fully concur in the wisdom of his recommendations as adopted.

The rotary transformers approved by Professor Forbes and made by the General Electric Company are worthy of the highest praise for both design and execution.

5. In fine, the extraordinary and gratifying progress in the development of transforming apparatus, and a corresponding reduction of cost, have taken away many, if not all, of the reasons which Lord Kelvin gave against the adoption of Professor Forbes' original recommendation of the alternating current, which now, as he truly says, "alone solves the problem well and economically."

FRANCIS LYNDE STETSON.

LONDON, July 31, 1895.

Sir:—LORD KELVIN'S prepossession in favor of continuous currents as against alternating currents is not supported by modern electrical practice, save for the restricted purposes of electrolytic decomposition. On the contrary, for nine-tenths of all other purposes the advantage is found to lie on the side of alternating currents wherever the distance of transmission exceeds a few hundred yards. Lord Kelvin points to the use at Niagara of a special commuting machine to transform alternating currents to continuous, for a certain electro-metallurgic process, as though the fact that it had been necessary to add this adjunct condemned the use of alternating currents. It proves, however, the precise contrary. All the so-called continuous current dynamos really generate—as Lord Kelvin knows well without any reminder from me—alternating currents which are then commuted into continous currents by a costly mechanical device called a commutator affixed to each machine. It is now recognized by electrical engineers that for nine-tenths of ordinary purposes, such as electric lighting and transmission and distribution of power, it is far better as well as cheaper not to add any commutator. By adding it most of the advantages of alternating currents are simply thrown away, and endless troubles are introduced by the sparks at the commuting brushes, to say nothing of other drawbacks. It would be a great pity if the immense influence of Lord Kelvin's opinion were to be used against progress.

SILVANUS P. THOMPSON.

LONDON, Aug. 1, 1895.

GAS AND ELECTRIC HEATING.[1]

BY H. J. DOWSING, M.I.E.E.

AT a recent meeting of the Société Technique de l'Industrie du Gas, of France, M. G. Perthius read a paper on "The Cost of Heating by Electricity." This paper is interesting as showing that electric heating has become of sufficient importance to warrant gas engineers spending their time in denouncing it, and endeaving to prove that electric heating is more costly than gas. Any electrical engineer will acknowledge that a unit of heat produced by electricity at the present charge for current is more costly than that produced by gas, and it is merely flogging a dead horse to endeavor to prove it. The question, however, is not how much does it cost to produce a unit of heat, but *how much of it can you use?* We may, for instance, have any amount of cheap power in the waves of the sea, but how much of it can we employ for practical purposes? It is usually found more profitable to employ steam engine, and pay for every foot-pound produced, rather than to attempt to use wind-power—not only on account of its unreliability, but largely on account of the uneconomical means we have to employ for its utilization. This line of argument should appeal especially to gas engineers, for they entirely depend upon it to prove the economy of gas as a heating agent. M. G. Perthius, in his paper, said that he thought it necessary to throw some light on the subject of the cost of heating by electricity, owing to the sensational articles that were being published, and goes on to state that "whatever might be the source of electricity, its high cost made its practical adoption impossible." Has M. G. Perthius ever heard of electricity produced by water-power? Does he really think that gas, or any other fuel, will produce heat cheaper than can be produced by this means? I know of a large mill driven by water-power where some £700 a year is spent for fuel to maintain the heat necessary for the particular manufacture carried on. The millowners are now about to utilize more water-power, which costs them practically nothing, and warm their mill by electricity. Besides obtaining heat at a very low cost, they will have the advantage of being able to regulate the temperature better than by any other means. In works with ample steam-power, electrical heating can often be produced cheaply, and in large houses with private plants, electric heating can be obtained, especially during the day when it is most required, at as low a cost as by other suitable means. M. G. Perthius bases his comparisons, however, on the very safe grounds of the supply companies' charges, which are well known to be a long way off their lowest point. In order to make a comparison, the writer of the paper takes the cost of heating a ton of water by gas and electricity. Now most people are satisfied to take the cost of heating a pint of water, or at most a gallon, especially as few private houses require *tons* of water heated per day. We are told that with electricity at 5½d. per unit, it would cost 6.3d. to produce heat sufficient to raise a *ton* of water 1° Centigrade, while with gas at 6s. 8d., it would only cost ¼d. It would have been interesting if M. G. Perthius had carried his calculations a little farther, and added the information that with coal at 25s. per ton, the same amount of heat would come to *one twenty-fourth* the cost of gas. With such figures only before us, it would seem surprising that anyone should dream of using *even gas* for heating purposes. One thousand cubic feet of gas at its highest calorfic value (696 units per cubic foot) will produce no more heat units than 55 lbs. of coal. Gas cost, say, 3s., and coal 7d. Why then is gas used for heating at all? *Certainly not because the heat is produced at a cheaper rate*, and this knowledge no doubt accounts for the delay in the gas companies taking up heating and cooking in the first instance. Luckily for the manufacturers of gas stoves (and the gas companies themselves), electric lighting came along and gave the desired impulse. Probably a similar period of incubation is going on in the minds of the directors of electric supply companies at the present time, and some kindly opposition is required to hasten the process. It does seem strange that, with the gas companies' experience before them, smart business men should allow hundreds of horse-power to be dissipated daily without a strenuous effort to dispose of it in a field which is illimitable. Interest on the many thousands of pounds representing the cost of a central station must be earned (together with all costs of working) by the average demand of less than two hours per day. Most companies manage to pay a dividend on this two hours' demand, and if only another two hours' demand could be obtained *at another part of the day*, a double income on the same capital expenditure would be assured. The cost of interest, depreciation, management, and the fixed charges generally, are covered daily by the price per unit charged for lighting. This is acknowledged in Wright's system of charging, and any subsequent demand for current is charged at half rate. An equitable system would be to allow consumers the privilege of using up to their maximum demand during the day at slight extra charge on works cost. A customer having already paid in the price charged per unit for light, a sum representing interest and fixed charges on the amount of machinery necessary to produce the current required, ought not in all fairness to be called upon to pay these charges over again on that day, because he happens to require the current at another time for another purpose. If these matters are taken into consideration, the price charged per unit for "extra" uses would be so low as to, in many cases, approximate the cost of gas.

The reason that more expensive methods of heating than coal may sometimes be used with economy depends, as above stated, as much upon the heat utilized as on the cost per unit to produce. Thus, with our English custom of heating by means of an open fire, 90 per cent. or more of the heat produced from coal is usually wasted, but in the most efficient forms of gas heating apparatus 60 or 70 per cent. may be utilized. This at once shows that the disparity as to cost is not so great as at first sight appears. Add to this the greater convenience and cleanliness, and we see at once why gas may be sometimes used with comparative economy. There is not so great a difference in the cost of heat produced by electricity and gas, as between gas and coal, and when it is remembered that electrical heating apparatus is in many cases far more efficient than either coal or gas, we see that there is a possibility of using it, although the heat unit may be more costly to produce. The electrical system of heating has more advantages over gas than gas over coal. Not only is the electrical system more convenient than gas in being more portable, but it is even more cleanly, for there is an entire absence of combustion. The objectionable smell of gas which in some cases entirely prevents its use is one of the penalties which has to be paid for convenience, but there is no such drawback with electricity. Danger of explosion there is none, and an almost entire absence of danger from fire. Are not these advantages well worth paying for? While the cost of electric heating is more than gas, electricity is steadily replacing the more expensive systems of producing heat as, for instance, the spirit lamp.

With electricity and gas at their present prices, I should recommend no one to use either system for boiling large quantities of water such as are required for household purposes. The only really economical way is to use a separate tubular boiler with coal or coke as fuel. If this system is adopted, all cooking operations can be carried on by electricity with advantage. For cooking purposes far less heat is required than is generally supposed.

1. From the London *Electrical Review*.

In a trial with a gas oven, it was found that out of a total of over 18,000 heat units required in roasting a joint of 8¼ lbs., only 2,203 units were actually used in the food itself, the altogether disproportionate amount of 11,000 heat units being dispersed wastefully. Thus out of a total of 22 cubic feet of gas burned, only 3½ cubic feet were used in cooking the food, or, say, 16 per cent. When it is remembered that the oven is one of the most economical systems of cooking by gas, and more efficient than cooking by coal, it ought not to be a difficult thing for electricity to compete, despite its higher present cost.

Electricity must be compared with gas in the same manner as gas is compared with coal, *i. e.*, its efficiency and advantages must be taken into account. I no more expect that electricity will supersede gas for every heating purpose, than I believe gas will ever supersede coal as a fuel. Each system will have its place, and electricity will be used (as gas is now) where its greater advantages are valued, and not because it is always cheaper to use.

With the extravagant ideas at present abroad as to the amount of heat required for cooking purposes—based, no doubt, on the wasteful systems now in vogue—it may probably surprise many to know that the energy used in a 16 C. P. lamp for one hour would nearly suffice to cook a pound of meat. Of course, the heat would be used, say, in a quarter of an hour, but the energy would be the same.

In criticising the paper above referred to, one of the speakers stated that, in his experience, you could do the cooking by any ordinary system while waiting for the heat to be generated by electricity! This is arrant nonsense. The rate at which the heat is generated depends entirely on the amount of energy used. Heat is generated immediately the current is turned on, and because the makers of electrical cooking apparatus usually find it necessary to make the current small in order to use the existing house wires, it is no reason why a much quicker system should not be employed. Has M. Henri ever seen an electric fry-pan? Within a few seconds it is too hot to touch, and in a minute—or, at most, two minutes—it is ready for use. By what system could the food be cooked in two minutes? M. Delahaye did not think electricity would be used for cooking. Many gas engineers think the same with regard to electric lighting, and I know at least one who is ready to prove to anybody that electricity cannot be made at a price low enough for the electric light to be largely used. Electric heating, as most up-to-date engineers know, is rapidly spreading, and it will soon be a rarity to find a house where electricity is used at all in which at least some form of electric heating apparatus is not to be found. The use of the larger kinds of apparatus will depend very much upon the action of the supply companies, but there are signs that before long electricity will be cheap enough for use in many ways at present out of the question. One instance will show this. Several applications have been received from bakers who wish their ovens fitted for electric heating, but with current at the present charges the cost of working would be prohibitive. What a field for the supply companies! There are thousands of ovens which would require current from *midnight to early morn*. Probably no other outlet of so promising a nature could be found. To sell current when there is not even a day load available seems to be a move in the right direction.

ELECTRIC POWER TRANSMISSION AT FRESNO, CAL.

An interesting long distance power transmission plant is in course of construction at Fresno, Cal., which is unique in more than one particular. The head of water to be used is 1410 feet and the distance of transmission about thirty-five miles. The natural conditions surrounding the installation are extraordinary in themselves. The water for supplying the power is taken from the North Fork of the San Joaquin River at their confluence. The stream of the North Fork runs for several miles down a rocky canyon, forming rapids and cataracts as it runs between the steep mountains. At the head of the rapids a canal will take the water out upon the summit of a high ridge, which it will follow for six miles to a point nearly fifteen hundred feet above the San Joaquin River. Here a reservoir has been constructed with an average depth of ten feet. It covers about eight acres and can be made both larger and deeper, should the demand for power require an extension. Into this reservoir, the water brought along the ridge by the canal will be stored, but it will be used solely as an emergency store. It is calculated that it will hold enough water to drive the machinery for several days, so that should a break occur between the reservoir and the source of supply, the electrical work could continue until the repair was effected.

A pipe line runs directly from the canal a distance of about 4,000 feet, to the power house and the head of water obtained will not be less than 1,410 feet. The pressure at the bottom will be 600 lbs. to the square inch. The lower end of the pipe line is of welded steel pipe, ¾ inch thick, having special steel flanges and special packing at the joints. The amount of water power available is at least 7,000 H. P. at the head above mentioned.

All possible accidents are provided against. Should a break occur near the lower end of the pipe the rush of water would form a vacuum near the upper portion of the pipe and it might collapse under atmospheric pressure. An air valve will be placed near the top to provide against this contingency. The pipes will be made in sections of twenty feet each. At the upper end the metal will be ¼ inch thick and the pipe 24 inches in diameter. It will be fastened to the granite mountain sides by steel cables.

The power station will be located at the bottom of the mountain, and will contain three Pelton water wheels, 58″ in diameter, driven by a single nozzle. The generating plant will consist of three 340 K. W. General Electric Company's three-phase generators. The three-phase system has been selected in this case as the system which will give the highest efficiency of transmission with the lowest cost of copper.

From the point in the North Fork of the San Joaquin River, where the water is taken to the power house at the foot of the mountain, is a distance of about seven miles. From the power house to Fresno, where the electricity will be utilized is about 81¼ miles in a direct line, or 35 miles by the pole line. The line will consist of two circuits of bare copper wire, consisting of six wires strung on poles forty feet high. The current will be delivered to the lines at a pressure of 11,000 volts. From the power house the line will rise to the level of the San Joaquin, cross it and pass through a portion of the Auberry Valley, then rising over the Red Mountain, passing about a mile west of Clovis will continue direct on to Fresno. The first five miles will be over moderately level country, the other thirty through an open and practically level country under ideal conditions for transmission. It is estimated that the power which will be delivered in Fresno at present from the three-phase generators will not be less than 900 H. P.

At the Fresno end the line will be brought into a sub station and there current will be transformed down. From the sub station power will be delivered to all the mills in town, the water works, machine shops, planing mills, laundries, printing presses, elevators, packing houses, etc. It will also be used to drive the street railway system of the city which will require about 800 H. P. In the sub station, two arc dynamos, each of 60 lamps capacity will be driven by an induction motor, the motor being mounted on the same bed plate as, and being direct connected to, the dynamo. Current will be supplied for 4,400 incandescent lamps.

Gas and fuel in the San Joaquin Valley has always brought an extremely high price and this may be considered as the most potent reason for the present installation. It is believed that power can be supplied when the plant is started at about half its present cost; and to the towns around Fresno the privileges of electricity will probably be extended as soon as possible. This plant may easily be considered as taking the lead in the use of a high head of water and the distance over which the power is transmitted.

THE GENERAL ELECTRIC-WESTINGHOUSE DEAL.

A dispatch dated Pittsburgh, Aug. 18, reads as follows: In view of recent reports that the Westinghouse Electric and Manufacturing Company and the General Electric Company were negotiating to combine their companies, Mr. George Westinghouse was seen to-night. He said:

"Three months ago Mr. Twombly, a director of the General Electric Company, had asked me if the Westinghouse Company would be willing to exchange patent licenses upon a basis which would terminate the costly litigation between the two companies. Mr. Twombly was informed that the Westinghouse Company would enter into a general exchange of licenses, and a memorandum was drawn and committees were appointed by the parties to discuss an agreement upon the lines of such memorandum. No meetings of those committees were held, for reasons which only the General Electric officials can explain. It is said to have been due to irreconcilable differences among themselves."

Mr. Westinghouse went on to state that after some delay further offers and negotiations were made and committees were appointed for both companies. These committees met in New York on last Tuesday, Wednesday and Thursday, Charles A. Coffin, President of the General Electric Company, being one of its committee. An agreement was apparently reached, but this was afterward receded from by the General Electric Company. They afterward asked for thirty to sixty days to reconsider the subject. Then the Westinghouse Company declined to go further, believing that the negotiations had already been used in Wall street for stock jobbing purposes. The suggestion made that the companies had agreed upon prices and a division of territory was erroneous, Mr. Westinghouse said.

We have received from Messrs. G. T. Evans & Co. of Pittsburgh, Pa., a very handy Table for Computing Weight, Losses, etc., of Copper Wires. It ought to prove very useful in the hands of wiremen, contractors, etc.

MEETING OF THE ASSOCIATION OF EDISON ILLUMINATING COMPANIES AT DETROIT.

The Eleventh Annual Meeting of the Association of the Edison Illuminating Companies was held in Detroit, August 18, 14, and 15, 1895.

The first session of the Convention was called to order Aug. 18 at 10 a. m. by Mr. C. L. Edgar, President.

The members present were:

New York:—J. W. Lieb, Jr.; Arthur Williams; Luther Stieringer; S. D. Greene; A. D. Page.
Detroit, Mich.:—W. S. Thompson; E. M. Clark; Geo. Wiley; Geo. W. Cato; Geo. Peck; Hoyt Post, Attorney Detroit Company; O. P. Gilbert.
Cincinnati, O.:—John I. Beggs.
Rochester, N. Y.:—Geo. A. Redman.
Brooklyn, N. Y.:—W. S Barstow.
Grand Rapids, Mich.:—Daniel McCoy; A. F. Walker.
Cleveland, O.:—Samuel Scovil; Robt. Lindsay.
Toledo, O.:—Winfield S. Jewell.
Boston, Mass.:—C. L. Edgar.
Chicago, Ill.:—B. E Sunny; Samuel Insull; F Sargent.
Schenectady, N. Y.:—J. R. Lovejoy; W. S. Andrews; Caryl D. Haskins.
Atlanta, Ga.:—H. T. Edgar.
Cumberland, Md.:—J. S. Crider.
Rockford, Ill:—M. A. Beal.
Kansas City, Mo.:—Edwin R. Weeks.
New Bedford, Mass:—Chas. R. Price; Geo. R. Stetson.
Columbus, O.:—A. W. Field.
Hagen, Germany:—Adolph Muller.

After the roll call the Executive Committee represented by its Chairman, Mr. John I. Beggs, made a report recommending the acceptance of the application of three companies for admission, namely, the Edison Light & Power Co., Pottsville, Pa.; the Toledo Electric Co., Toledo, O.; the Sault Ste. Marie Co., Sault Ste. Marie. The companies were admitted to membership.

A report by Mr. A. E. Kennelly, of the Committee on Lightning Protection, Grounding the Neutral in 3-wire Systems, Crosses with High Tension Systems, was accepted and the committee discharged.

Addresses were then made by Mr. S. D. Greene of the General Electric Co., Mr. Samuel Insull of Chicago and Mr. J. I. Beggs of Cincinnati, on "the Relations of the General Electric Co. to Edison Licensee Companies."

After considerable discussion, a paper by Mr. W. L. R. Emmett of the General Electric Co. was read, entitled "Some Comparison between the Direct Current Low Tension System and the Alternating Current and Multiphase System for Central Station Lighting." Mr. Emmett was unavoidably absent and his paper was ordered printed in the minutes. The session then adjourned.

The second session was held at 2 P. M. and the Storage Battery Committee made a report. Discussion followed Mr. Müller, of Hagen, Germany, Mr. C. L. Edgar, and Mr. J. W. Lieb, Jr., gave their experiences. A paper by Messrs. Pierce & Hale was then read by Mr. C. L. Edgar of Boston, entitled "Energy Losses in the Boston Edison Station."

After discussion on this paper, the session adjourned.

The evening was given up to a car ride and visit to Lalla Rookh, the members being the guests of the Detroit Edison Co.

August 14.

The third session was called to order at 10 A. M. A paper by Mr. W. S. Barstow on "Method of Charging for Current for Incandescent Lamps and Motors," provoked much discussion and with Mr. Arthur Williams' paper, "Relation of Company to Customer" occupied the entire morning. The session adjourned at 1 P. M.

The fourth session opened with a discussion by Mr. Beggs, Mr. Greene and Mr. Howell on Incandescent Lamps, Welsbach Light and Acetylene Gas.

A paper by Mr. C. D. Haskins on "Facts in Relation to Mechanical Recording and Chemical Meters" was then read and discussion followed.

The evening was taken up by a drive and lunch on Belle Isle, by courtesy of the Detroit Edison Co. and the General Electric Co.

August 15.

In accordance with past custom, the last day of the Convention was given to entertainments. This took the form of a delightful sail along the river at the invitation of the Detroit Edison Co. who, together with the General Electric Co., received the thanks of the Convention for their past courtesies.

Convention Notes.

The meetings of this Convention were particularly interesting on account of the lengthy and interesting discussions on the various papers. Mr. Edison sent regrets for his inability to attend as he was unable to leave his mining interests at Edison, N. J.

The General Electric Co. presented each member of the Association with a handsome badge representing the fields of a multipolar generator, from the centre of which hung a miniature incandescent lamp. The title of the association, the place of meeting and the date were neatly arranged around the field.

The next Convention will be held in, or in the vicinity of Brooklyn, commencing the second Tuesday in August, 1896, and continuing three days.

Among the non-members who attended the Convention we noticed: Mr. E. W. Little, of the Interior Conduit and Insulation Co., New York; Mr. Geo. A. McKinlock, Central Electric Co., Chicago; Mr. Benj. F. Miles, of the National Carbon Co., Cleveland; Mr. Wallace Franklin, Westinghouse, Church, Kerr & Co., Grand Rapids; Mr. Albert Hoppin, of Allis & Co., Milwaukee; Mr. Martin Insull, of Sargent & Lundy, Chicago; Mr. Charles Wells, of The Electrical Appliance Co., Chicago; Mr. J. S. Crider, of the Washington Carbon Co., Pittsburg, was also present as a delegate.

The only exhibit, if one could call it one, was the Fisher rotary engine in the basement of the Cadillac Hotel. It appeared to be a very practical machine.

REPORTS OF COMPANIES.

BOSTON ELECTRIC LIGHT CO.

The annual report of the Boston Electric Light Company for the year ending June 29, 1895, shows total income, $610,265; operating expenses, $411,449; net, $198,815, less interest on bonds and loans, $31,855, and dividends, $136,000; leave surplus, $30,889; total balance to credit profit and loss, June 29, 1895, $372,611.

GERSON ELEC. MFG. CO.

The Gerson Electrical Manufacturing Company of Philadelphia has made an assignment for the benefit of creditors to George W. Wilgus. The deed is dated July 15, and conveys no real estate.

EDUCATIONAL.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

The programme for 1895 of the Massachusetts Institute of Technology gives in detail the course of instruction with a statement of the requirements for admission and a list of the officersr The equipment of the electrical laboratory includes a large numbe of dynamo machines of various patterns, both arc and incandescent, devoted to purposes of instruction. Among these are a 150-light Edison dynamo, and a 9,000 watt, Thomson inclined coil, constant potential dynamo. A 500-light Thomson-Houston alternating current machine, with transformers of various types, also forms a part of the equipment. A 500-light United States direct-current compound dynamo is used for lighting the Engineering Building, and is available for purposes of instruction, as are also several multiphase generators and motors. The laboratory also possesses a number of Thomson-Houston and Edison street railway motors, both bipolar and multipolar.

UNIVERSITY OF NEBRASKA.

The announcement of the course in the Department of Electrical and Steam Engineering in the University of Nebraska for 1895-96, has been received.

The equipment of the electrical laboratory is chosen largely to represent distinct systems of lighting and power. For incandescent lighting: the Edison two-wire, the Edison three-wire, and the Westinghouse high pressure alternate current systems are complete. In addition to these complete systems there is switchboard equipment for the Thomson-Houston alternate current systems, and transformers of the Thomson-Houston, Wagner, Packard, Slattery, and National types. There are also constant pressure dynamos of the Weston and the Donaldson-Macrae designs.

For arc lighting: the Thomson-Houston system representing the open coil, and the Wood and Excelsior systems representing the closed coil types, are complete. Besides this are the T.-H. alternate current system of arc lighting, and the various types of constant direct current arc lamps.

For power and power transmission: the direct and alternate current systems are represented, among which is a Donaldson-Macrae motor plant, the three phase system of the Allgemeine Electricitäts Gesellschaft," and the Scott system of polyphase distribution. The Department is in charge of Prof. R. B. Owens.

ATTEMPTING TO WRECK A STATION AT HARVEY, ILL.

The Chicago *Dispatch* of Aug. 7 says:—An attempt was made last night to damage the electric light plant at Harvey. Emery was poured into all the oil cups and bearings. Fortunately, the cups were all cleaned before starting up the machinery, when the emery was discovered. Had the attempt succeeded Harvey would have been in total darkness for the night.

PERSONAL.

DAVID LEONARD BARNES.

David Leonard Barnes.

THE recent working arrangement concluded between the Westinghouse Co. and the Baldwin Locomotive Works was coupled with the announcement that the joint operations of the two companies would be under the technical supervision of Mr. David Leonard Barnes whose name is well known in the railroad world.

Born in 1858, Mr. Barnes finished his classical education at Brown University, where he graduated with the degree of Master of Arts. Being of a mechanical bent he determined to devote himself to engineering and with that end in view entered the Massachusetts Institute of Technology, following the course in Mechanical Engineering. Shortly after graduation Mr. Barnes entered the drafting room and machine shop of the Rhode Island Locomotive Works, remaining there from 1878 to 1888 and accumulating a vast amount of experience in the construction of railroad rolling stock. In 1883, Mr. Barnes accepted the position of chief draftsman for the New York Locomotive Works, but resigned a year later to accept the position of chief draftsman and mechanical engineer for the Rhode Island Locomotive Works which position he occupied until 1887.

In that year Mr. Barnes opened offices in New York and Chicago, as consulting engineer, making a specialty of railroad rolling stock and operation, elevated and street railways, and electric plants. Mr. Barnes' technical writings have always commanded attention; he is the author of papers on a variety of scientific and technical subjects and of a work on Compound Locomotives. As Mechanical Editor of our excellent contemporary the *Railroad Gazette*, his writings reach a large audience in the railway world. Mr. Barnes is a member of the American Society of Mechanical Engineers, the American Society of Civil Engineers and of other engineering and railroad associations.

MR. LEO DAFT, the well known electrical engineer has removed his offices to Room 408, Stimson Building, Los Angeles, Cal.

MR. C. F. HUTCHINGS, of Pittsburgh, has been appointed Electrical Superintendent of the Wilmington City Railway Company.

MR. WILLIAM C. BENBOW who has for the past six or seven years been with the Engineering and Mining Departments of the Thomson-Houston and General Electric Companies has recently resigned his position to assume the management of the mines of the Cambridge and Guernsey Consolidated Fuel Co., at Cambridge, Ohio.

MR. HARRY B. COX, of Hartford, has returned from Europe, where he has successfully disposed of the English and European patents on his thermo-electric apparatus. Mr. Cox reports that he has had over eleven hundred inquiries directly from the recent illustrated article in the columns of THE ELECTRICAL ENGINEER, and that his device elicited the most intense interest among English electricians.

LETTERS TO THE EDITOR.

THE RELATIVE ECONOMY OF CONSTANT POTENTIAL AND CONSTANT CURRENT ARC LIGHTING.

I HAVE been several times on the point of setting on foot a discussion, so opportunely introduced by Mr. W. N. Stewart in your issue of August 7, as to the relative economy of constant potential and constant current arc lighting systems. Now that the question has been seriously raised by Mr. Stewart, and has elicited a reply from Mr. E. R. Knowles in your issue of the 14th inst., the following notes, which I hope to substantiate at some future time by the figures themselves, may prove of interest.

In June, 1894, the Edison Electric Illuminating Co. of Brooklyn began lighting the streets on an extensive scale by means of constant potential arcs run from their underground mains. As this plan was more or less of an experiment, it was to be expected that the operating expenses of the first six months would be far in excess of the normal; and that a comparison between this new system and the older, or constant current, system would therefore be unfair to the former. Frequent inspections of the machinery, appliances and personnel of the various companies operating in Brooklyn have gradually led me to the belief that the constant potential arc lamp can hold its own against its older rival.

On July 1, 1895, the Citizens' Electric Illuminating Company, operating constant current arc lamps, passed under the control of the Edison Company. I at once endeavored to obtain comparative figures on economy, but without success, since totally different methods of account keeping were employed, and it was necessary to reduce to a common basis of comparison one system all underground with ornamental iron bracketed poles and serving incandescent lamps as well, and another system nearly all overhead with wooden poles and mast arms and serving arc lamps only. However, the subject has received considerable attention at the hands of the Edison authorities and myself; and with the promised assistance of the former there may be some figures forthcoming as soon as the operation of the two systems under one management and one system of bookkeeping will furnish the data.

Even should these figures prove, as I think probable, that the economy of constant potential arc lighting on a mixed circuit (arc, incandescent and motor) is greater than that of constant current arc lighting on a purely arc circuit, thus upholding Mr. Stewart's argument, the points submitted by this gentlemen have a still wider application, and may be used in comparing a pure, constant potential with a pure constant current arc system.

As Mr. Knowles intimates, it is doubtful whether anyone would seriously advocate the use of a pure constant potential arc system; and yet, five years ago the Siemens & Halske people not only advocated, but actually installed, such a system in Tokyo, Japan, to supply quite an extended area. In this instance the dead resistance consisted of a carefully proportioned lead from one lamp to its mate. On our ordinary constant potential mixed circuits the dead resistance for each pair of lamps takes up from thirty-five to forty volts. How much of this is essential for the elasticity of the circuit? Can we not cut this resistance down so as to make a constant potential pure arc lighting system, with its improved machinery, smaller floor space, decreased attendance and absence of belting and countershafting, a commercially desirable installation? Is there not a field for such a system in the territory now covered by the constant current system, similar to that occupied by the low tension system in the incandescent lighting industry? With no lamps or motors to bother us, we can make the voltage of our circuits practically what we please, and the dead resistance is no longer required to *take up voltage*, but merely to give elasticity.

The old, old story of the greater economy of the constant current system has lost its charm—except it be accompanied by figures. We have learned this story, just as we have learned our politics and religion, by being so taught when we were young. Now it is time either to quit believing, or to know *why* we believe. Will those who know please tell us?

H. S. WYNKOOP, M. E.

BROOKLYN, August 14, 1895.

[THE subject here under discussion is one of vital importance in electric light economy and we will be glad to give space to further contributions on it. EDS. E. E.]

THE REGULATION OF THE POMONA PLANT.

IN the *paper* on the "Pomona Plant," read before the Amer. Inst. of Elec. Engrs., by Mr. G. H. Winslow, the writer makes some statements in regard to the regulation, here, which are hardly up to date.

There is practically no hand regulation used in this plant, as, owing to some more careful adjustments, made some time ago, there is no "see-sawing." All the *hand* work we do, is making slight changes in the *field* charge, to compensate the difference in speed between electrical changes of load and the slower action of the water wheels.

JOHN E. ADAMSON, Electrical Engineer,
San Antonio, Cal., Light and Power Company.

SAN ANTONIO, CAL., Aug. 5, 1895.

LIGHTNING DRIVING ELECTRIC CARS.

REFERRING to your article headed "Can Lightning Run Trolley Cars?" in the issue of August 7, I would suggest that in the instance mentioned by the Connecticut reporter the lightning traveling along the conductor entered the motor by arcing across the spaces between contacts in the controller box, actuating the armature through the contact which first throws the current into the armature, thus causing the car to move. It is quite probable that there were other paths of escape along the line for the lightning discharge which prevented the armature being burned out.

J. M. NAYLOR.

JERSEY CITY HTS., N. J., Aug. 11, 1895.

SCIENTIFIC USES OF LIQUID AIR.[1]—I.

BY PROF. J. DEWAR, F. R. S.

WHEN Faraday was working on liquid gases in this Institution about 1823, with such means as were then at his command, his inquiry was limited to the determination of the specific gravities and vapor pressures of such bodies. Twenty years later, by the use of solid carbonic acid, the greatest cold then possible was obtained, and Faraday made admirable use of Thilorier's new cooling agent to extend his early investigations. Just as liquid carbonic acid produced in glass tubes was of no use as an agent for effecting the liquefaction of more resisting gaseous matters, until it could be manipulated in the solid state, so liquid air, until it could be handled, stored and used in open vessels, like any ordinary liquid, could not be said to possess scientific uses in any wide sense. Such operations become easy when double-walled vacuum vessels (such as were described in a former lecture) are employed in the conduct of experiments where substances boiling at very low temperatures have to be manipulated. The chief scientific use of liquid air consists in the facilities it gives for the study of the properties of matter at temperatures approaching the zero of absolute temperature. In this lecture the expression liquid air may mean either oxygen or air. Where a constant temperature is required oxygen is used. Liquid air made on the large scale may contain after it is collected in open vacuum vessels, as much as 50 per cent. of oxygen. Such a liquid boils between —192°C. and —182°C., and the longer it is stored the nearer it comes to —182°C., or the boiling point of pure oxygen. For a number of experiments of a qualitative character, whether it is liquid air or oxygen that is used makes no difference. In many of the experiments to be recorded, liquid oxygen made from the evaporation of liquid air was employed. In pursuing this subject in consort with Prof. Fleming,[2] a long series of experiments, involving the use of large supplies of liquid oxygen, have been carried out on the electric resistance of metals and alloys, and the results warrant the conclusion that at the zero of absolute temperature all the pure metals would be perfect conductors of electricity. Under such conditions a current of electricity started in a pure metallic circuit would develop no heat, and therefore undergo no dissipation. Similarly, we infer there would be no Peltier effect at the zero. In other words, the passage of electricity from one metal to another would take place without evolution or absorption of heat.

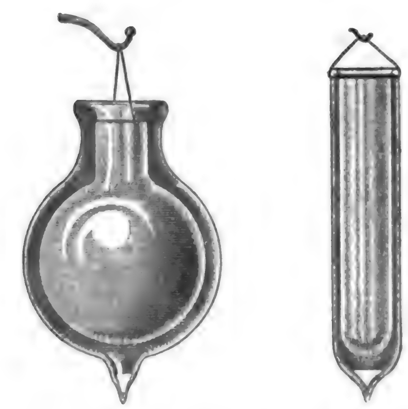
Further investigation, along with Prof. Liveing,[3] on the refractive index of liquid nitrogen and air, has led to the conclusion that the refractive indices of nitrogen and air are respectively for the D-ray, 1.2053 and 1.2062. In these determinations, instead of using the prisms, we have employed the method of Terguem and Trannim, which consists in suspending in the liquid two plates of glass with a thin layer of air between them, and measuring the angle of incidence at which the chosen ray suffers total reflection at the surface of the air. As all the vacuum vessels are either spherical or cylindrical in form, when filled with liquid they act as lenses which are irregular and full of striations. Further, small bubbles of gas being given off in the liquid rendered any image indistinct when viewed with a telescope. In order to avoid the necessity of observing any image through the liquid, it was used simply as a lens to concentrate the light observed on the slit of a spectroscope. Under such conditions the observations were easily executed, and the results satisfactory.

For some time a series of observations on the thermal opacity of liquid oxygen and nitrogen have been projected. It is, however, exceedingly difficult to experiment in such a way as to eliminate the absorbing action of the glass vessels, and as the use of rock salt is impracticable, the absorption of heat of low refrangibility remains for the present undetermined. It is possible, however, to use the glass vacuum vessels to determine approximately the relative thermal transparency for heat of high refrangibility, such as is radiated by a colza lamp. The following results represent the heat transmitted through the same vacuum vessels filled with different liquids, taking chloroform as the unit for comparison and correcting for differences of refractive index :—

Chloroform	1.0
Carbon bisulphide	1.6
Liquid oxygen	0.9
Liquid nitrous oxide	0.93
Liquid ethylene	0.60
Ether	0.50

From this result it follows that liquid oxygen is nearly as transparent to high temperature heat radiation as chloroform, which is one of the most transparent liquids next to carbon bisulphide. Liquid ethylene is much more opaque. These results must, however, be considered only as an approximation to the truth, and as generally confirmatory of the inferences Tyndall drew as to the relation between gases and liquids as absorbents of radiant heat.

Instead of silvering the interior and exterior of the vacuum vessels, it is found convenient when using mercury vacua to leave a little excess of liquid mercury, in order that the act of filling the inner vessel with liquid air should cause a fine silvery deposit of the metal over the exterior surface of the inner vessel. In such a vessel liquid air or oxygen shows no signs of ebullition, the surface remains as quiet and still as if it was ordinary water. The supply of heat is cut down to less than 4 per cent. of what it is without exhaustion and silvering in good vacuum vessels. The result is that volatile liquids can be kept 30 times longer. Such vessels do not, however, maintain indefinitely the high standard of heat isolation they possess the first time they are used. After repeated use all vacuum vessels employed in the storage and manipulation of liquid air deteriorate. Illustrations of the appearance of such vessels are given in Figs. 1 and 2. The rapidity with which a space is saturated



FIGS. 1 AND 2.—VACUUM VESSELS FOR STORAGE OF LIQUID AIR.

with mercury vapor (which we know exerts a pressure of about one-millionth of an atmosphere) is easily proved by simply filling a barometer in the usual way, and then instantly applying a sponge of liquid air to a portion of the glass surface of the Torricellian vacuum space, when a mercury mirror immediately deposits. It is important to know the amount of mercury deposited from a saturated atmosphere which is maintained (containing excess of liquid mercury) at the ordinary temperature, the condensation taking place when liquid air or oxygen is discharged into a vessel surrounded by such a Torricellian vacuum. If the deposit on the cooled bulb is allowed to take place for a given time, the outer vessel can then be broken and the amount of mercury which coated the bulb ascertained by by weighing. Knowing the surface of the cooled bulb, the amount deposited per unit of area can be calculated. In this way it was found that in ten minutes two milligrammes of mercury per square centimetre of surface was deposited. Considering that one-tenth of a milligramme of mercury in the form of saturated vapor at the ordinary temperature corresponds to the volume of 1 litre, this proves that the equivalent weight of 20 litres had been condensed in the space of ten minutes. This plan of cooling a portion of the surface of a vessel by the application of a liquid air sponge, enables us to test our conclusions as to the amount of matter present in certain vacua.

1. Friday evening discourse delivered at the Royal Institution.
2. "The Electrical Resistance of Metals and Alloys at Temperatures Approaching the Absolute Zero." By James Dewar, F.R.S., and J. A. Fleming, F.R.S. *Phil. Mag.*, 1892.
3. "On the Refractive Indices of Liquid Nitrogen and Air." By Profs. Liveing and Dewar. *Phil. Mag.*, 1893.

SOCIETY AND CLUB NOTES.

SOCIETY OF THE U. S. MILITARY TELEGRAPH CORPS AND THE OLD TIME TELEGRAPHERS AND HISTORICAL ASSOCIATION.

THE Fifteenth Annual Reunion of these two societies will take place in New York, Sept. 11, 12 and 13, with headquarters at the Broadway Central Hotel. The programme of arrangements includes elaborate provisions for the entertainment of the members, including an entertainment at Chickering Hall, an ocean excursion to Long Branch, and general sight seeing. It is the desire of the Committee of Arrangements that every member of the Societies who can arrange to do so, should be present with his family at the Fifteenth Reunion. Notices of intention to attend the meeting should be sent to Mr. C. P. Bruch, 253 Broadway, Chairman Committee on Reception; for transportation rates, to Mr. J. F. Shorey, 195 Broadway; and for hotel accommodations and rates, to Mr. M. W. Rayens, 195 Broadway.

MR. J. F. BLAUVELT, of the New England Butt Co., of Providence, was a caller at this office this week and reported business in braiding machines to be steadily, if somewhat slowly, on the increase.

THE
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[INCORPORATED]

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CONTENTS.

THE "EXPRESS" TELEPHONE SWITCHBOARD.

ELSEWHERE in this issue we publish a description of the telephone switchboard designed by Messrs. Sabin and Hampton, of San Francisco, and known as the "Express" board. It is claimed that with the new system more efficient service can be given than is possible with the best type of "multiple" switchboard now in use. Inasmuch as the multiple switchboard utilizes the principle held by many to be the best possible to secure rapidity of operation, the claim that with a totally different construction superior results can be accomplished is one demanding serious consideration. One of the advantages claimed for the new switchboard is said to be its lesser cost of installation as compared with the multiple board. We can readily believe such a statement, as the latter involves a repetition of working parts in an extraordinary degree, while in the other there is no such repetition. But in considering the matter of cost it should be remembered that the time element in telephony is more important than economy of equipment. The telephone, to be of any use at all, must be a time saver, and no system, however cheap it may be, can displace another unless it can show itself at least equal to existing apparatus in the saving of time. A leading feature of the Sabin-Hampton system is that the labor of making connections is divided into three parts performed by different operators. The difficulty of getting operators to act in concert has always been recognized, and the experience gained in the working of an analogous though now obsolete type of switchboard has doubtless influenced inventors against the division of labor in telephone operating. In the system we describe, an elaborate arrangement of visual signals has been introduced, with the result, it is claimed, of securing concerted and prompt action on the part of the operators. The visual signals referred to form the most interesting part of the apparatus, and as the efficiency of the service entirely depends on their satisfactory action, their mode of working will repay close study.

THE ALTERNATING CURRENT IN RAILWAY WORK.

MUCH of the time of electro-technical bodies both here and abroad was formerly taken up with discussions on the relative advantages of the continuous and alternating current. The continuous current having been first in the field its advocates siezed every opportunity to point out how the alternating current was unsuited to all applications of power, and that such a system was practically debarred from enjoying the benefits of a large part of the earning capacity of a station. The introduction of the polyphase system has done perhaps more than anything else to bring about a parity between the two types of current, and though at present employed more generally for long distance transmission work, the number of central stations adopting the polyphase system is gradually but surely increasing. At the same time we notice several instances in which the polyphase current has been applied in railway work, among others at Sacramento, Cal., and at Lowell, N. H. In these instances it is true the alternating current is being converted to the continuous by rotary converters, but it shows a growing application of a method designed to avoid the use of heavy feeders. This application of the poly-

phase current seems to be but an opening wedge to a more direct application of the alternating current to the driving of the car itself. We know as a matter of fact that experiments with this end in view are being carried out in several quarters, and that while the results are not yet such as to warrant the offering of the system as a substitute for the continuous current, enough has been learned to afford encouragement for further experiments in the same direction. As to the type of alternating current to be used, whether single, two or three-phase, other conditions than mere efficiency and economy will have to be considered and more particularly that of the number of working conductors necessary. Both the two and three phase system would require at least two overhead conductors in addition to the ground return and this will no doubt militate against the application of either of these systems. We need only recall the strenuous opposition of the street railway companies to the adoption of the double trolley system which the telephone companies tried to force upon them in the early days of electric railroading, and which they even now spasmodically bring forward. This objection of course would not lie where the conductor system were placed underground. But with the general conditions of street railway traffic before us it will require most extraordinary conditions and advantages to induce railway companies to operate more than a single overhead wire and such being the case the single phase alternating current, for the present, seems the only one available, for general city traffic at least. The single-phase synchronous motor would therefore find its most immediate application and would call for special gearing to adapt it to the needs of the varying speeds of street car traffic. A number of such gears, among them those of the hydraulic type, are available and will probably find an early application to this work.

THREE CENT CAR FARES.

The trolley has won its way to a position of incalculable usefulness through a period of abuse without equal in its virulence, falseness and stupidity, and is now at the point where it is beginning to accomplish various utilities that its friends hardly dreamed of in the early days. People are now expecting impossibilities of it, and the press that so lately was full of scorn and contumely is now about as full of wild predictions of what the trolley is going to do for rural communities, and for high speed over long roads. We note another topic of recent origin upon which a great deal will shortly be heard, namely three cent car fares, which promise at no distant date to be in some places a further genuine benefit accruing from the adoption of electricity as a motive power. There can be no question that the trolley has brought a reduction of fare well within the range of practical politics, for in Detroit we already find the fine new Peck-Everett system selling tickets at 8 for 25 cents; while in a few other cities agitation or negotiation has already begun. Many roads would, we know, be seriously, if not fatally crippled at present by a fare less than 5 cents; but there are a number of plans that may become feasible, ensuring economy to the passenger without lessening the necessary income of the company. We are altogether too fond in America of running everything on the flat rate principle, which, satisfactory as it may be for rough and ready times, is altogether too crude for an age of science and a close adjustment of social economics and conditions. The rider who pays 5 cents for 2 cents of brief service has right in his complaint. It will be several years, probably, before the 3-cent unit becomes universal, but the tendency has already begun to manifest itself, and foresight must determine what is to be done about it. Not only in major, but in minor, aspects, the subject involves important considerations and careful calculation as to the amount of service that a road can honestly and legitimately give for so small a fare. The extent to which such a reduction might foster the habit of riding is also worthy of study, and no harm can be done by ascertaining the amount of short riding that can be worked up on minimum fares.

OFFICIAL EDICTS AS TO FENDERS AND HEATERS.

The Massachusetts Railway Commission has lately given the street car lines within its jurisdiction plenty of food for thought as well as an opportunity for work and expenditure by ordering a wholesale equipment of all cars with fenders and electric heaters. Both edicts might, it seems to us, be questioned on the score of propriety, perhaps even on that of legality; but they are a good sign of the times. We confess to having very little faith in the majority of the fenders now on the market, but such an order as this should be the means of bringing about a sharp and severe testing and analyzing of the different and multitudinous appliances, and should hold up the best in a strong light. Our regret is that the commission does not show itself equally emphatic in regard to brakes. Street cars need just as efficient brakes as steam cars do; and the air brake is none too good for them.

As for electric car heaters, we can only hope again that the step is not premature; and we venture to think that here again is a direct incentive to improvement, economy and perfection. Other States will certainly fall in line, and the demand anyhow this fall will be enormous. We are a little curious to see the effect on the power-house, for the change requires the generation of no small amount of current, with a corresponding increase in the dynamo and the engine capacity. There should be some very interesting records soon for statisticians to dissect. Whatever be the economy, there can be no doubt as to the gain in the cleanliness and healthfulness of the cars by the adoption of the new method.

TWENTY-FIVE YEARS OF EXISTENCE.

THE mortality of industrial concerns was long since proved to have a high rate, to which as elements of disappearance in late years may be added the practice of consolidation and the prevalence of trusts. It is a really noteworthy event to find a concern celebrating its quarter century, and we hasten to offer our hearty congratulations to the American Electrical Works upon such an anniversary, in the celebration of which a host of friends joined it last week. The electrical field has always been kaleidoscopic in its business changes, and there are not a great many that have lived through the growth of the telegraph, the birth of the telephone, the dawn of the electric light, and the rise of electric power. The insulated wire manufacturers have exhibited greater vitality than almost any other group, which can be readily understood in view of the fundamental nature of their product in all of the electrical arts,—and such names as Day's Kerite and Bishop recall at once the pioneer work that is now in reality more remote in years than in other qualities of present significance. When a house has lived through a quarter of a century and is in touch and sympathy with the times it has given no mean pledge of its ability to endure and prosper through further terms, and this happy lot will be desired by all of us for Messrs. Phillips and Sawyer and their associates, as well as for all other well-doers in this noble field of electrical industries and arts.

1870—1895.

TWENTY-FIFTH ANNIVERSARY AND SEVENTEENTH ANNUAL CLAMBAKE OF THE AMERICAN ELECTRICAL WORKS.

Eugene F. Phillips.

THERE was no need for any one to consult the weather prophets on last Saturday, August 17, for, as every one in the electrical business well knew, it was the day set apart for the annual bake given by the American Electrical Works to the electrical fraternity, and "Phillips' weather" as it has come to be known, was sure to ensue, and that meant fair skies, a glorious, warm sun, and cool, refreshing and inspiriting breezes from Narragansett Bay. These annual clam bakes are now familiar to most electricians, from Maine to California, are always enjoyed and looked forward to by busy city business men, who throw off their dignity once a year, and go in for a merry, light hearted time, just as they did years and years ago before they had gotten out of their teens.

This year, however, there was an added interest in the occasion, as the Summer of 1895 marked the twenty-fifth anniversary of the career of Mr. Eugene F. Phillips, the president of the American Electrical Works, in the manufacture of insulated wire for electrical purposes, and it might be truthfully stated, the twenty-fifth anniversary of the great electrical industry, which in 1870 was just about developing that potential force, which has since made it one of the leading industries of the world.

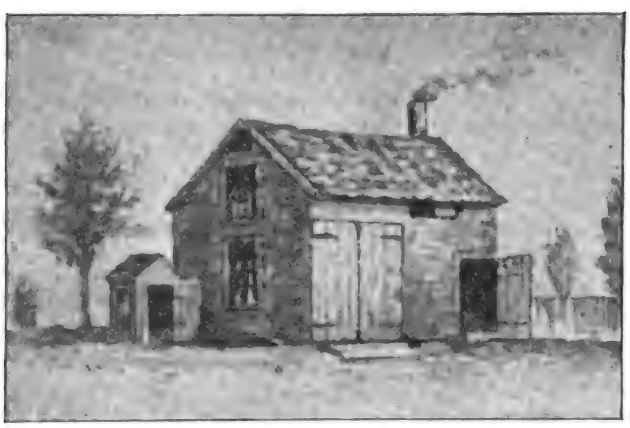
W. A. Hathaway.

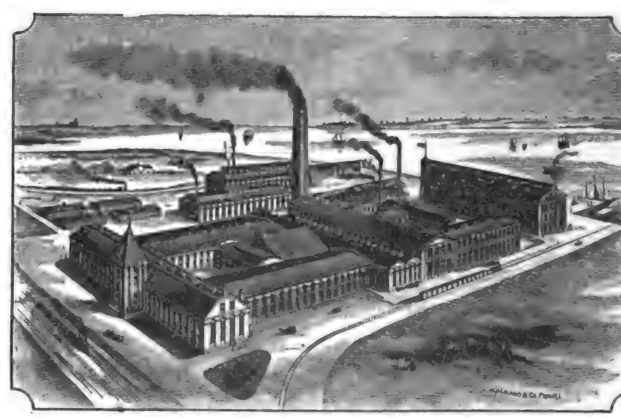
Such being the case we think a short history of the development of the American Electrical Works will be found interesting at this time. Previous to the year 1870, Mr. Phillips was associated as treasurer with the Atlantic Tubing Co. of Providence, a company which was engaged in the manufacture of flexible gas tubing. At that time the question of covering electric wire occurred to him, and as his company would not experiment in this new line, Mr. Phillips commenced to manufacture insulated wire in the barn of his own house, situated on Chestnut street, taking his power by means of a shaft from a jeweller's shop in the vicinity. His experiments in this line were successful, the business grew apace, and in 1874, commodious wooden buildings were built on Stewart street, and the manufacture of insulated wires became an established business. Soon it was necessary to increase the capacity, and the handsome brick buildings on Stewart street were erected in 1882, in which year also the American Electrical Works were incorporated, and as the business grew larger other buildings were erected until a large factory stood very near the site of the old barn where the business was begun in 1870.

W. H. Sawyer.

As new departments were added, however, to keep pace with the rapidly growing electrical industry, and larger cables became necessary, it became evident that even larger quarters were necessary, and in 1893, the site of the old Richmond Paper Works was secured at Phillipsdale, R. I., a little village named after Mr. Phillips, about two miles up the Pawtucket River, from Providence. The new factory contains about 2½ acres of floor space, and is surrounded by about 28 acres of ground. The company has a boarding house for its employees, a grocery store, and practically maintains the whole village. About 700 hands out of a capacity of about 1,000 are at present employed, and work is being carried on 20 hours out of the 24. The capital of the company is now $750,000, and they use about 3 car loads or about 75,000 pounds of copper bars a day.

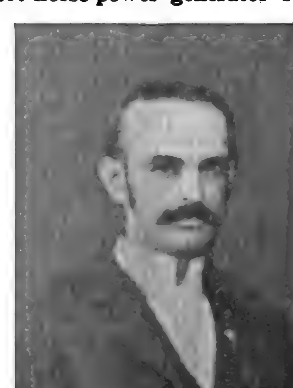
The most important innovation at the new factory, was the introduction of rolling and drawing mills, and now the company handles the copper just as it comes from the Lake in ingots, rolling it first into long rods about ⅜ of an inch in diameter, and then drawing it to any desired size from No. 0000 solid down to wires as small as one and one-half one-thousandths of an inch,—about half the diameter of the human hair. The factory is lighted by three 250-light incandescent dynamos, and one 85 arc light machine, and has a 250 horse-power generator for furnishing power to different parts of the factory.





1870. THE AMERICAN ELECTRICAL WORKS. 1895.

Mr. Phillips has been ably assisted since January, 1878, by Mr. W. H. Sawyer. This gentleman started his electrical career at the age of 14, and came prominently to the notice of electricians at the Centennial Exhibition, where he had charge of the electrical construction under Mr. W. J. Phillips. Mr. Sawyer was also one of the originators of the American District Telegraph Co., was at one time superintendent of the Gold & Stock Co. and American District Co., of New York, and was afterwards superintendent of the American District Telegraph Co., of Philadelphia. In 1878 he brought his practical



P. C. Ackerman.

electrical experience to the assistance of Mr. Phillips, and has ever since had charge of the practical manufacturing and the electrical department.

Mr. W. A. Hathaway joined the American Electrical Works in February, 1888, and Mr. C. R. Remington, Jr., in April, 1888. The history of these gentlemen is synonymous with the growth of the company. They entered the company as practically their first business experience, and have grown up with it, gaining in good will and popularity amongst the electrical trade, until to-day it would be difficult to find two men better known or more heartily admired and liked, in the electrical trade.

Mr. P. C. Ackerman, in charge of the company's New York office, dates his connection with the wire trade back for 12 years, of which 9 have been devoted to the service of the American Electrical Works. Frequent trips from Maine to California have, barring the staff of the Company, made Mr. Ackerman perhaps the best known man connected with it. Since the establishment of the Western office, at Chicago, under Mr. F. E. Donohoe, Mr. Ackerman has not travelled west of Chicago, but is popularly known to the trade in the Eastern States. His office is at 10 Cortlandt St., New York, and his figure is a familiar one in the electrical centre of the city.

As to the Clambake, what more can we say than we have said in previous years? About 200 guests accepted Mr. Phillips' kind invitation and partook of his royal hospitality at Haute Rive Club, and joined in the usual festivities, playing base ball, foot ball, striking with the heavy hammer, lifting heavy weights, and in all other conceivable ways, which men so well know when they are freed for a day from the cares of business. The base ball match was a tie, of course; that is the only safe way on these occasions, or the umpire's lot would otherwise, in the language of Gilbert, be "not a happy one." The usual electric athletes distinguished themselves to their own entire satisfaction, and records for all kinds of feats, not the least being the number of clams disposed of, were as easily beaten as in former years.

The after dinnner speeches were particularly happy. Mr. Thos. D. Lockwood, acted as toastmaster, though as in previous years, speechmakers confined themselves, or rather unconfined themselves, to subjects totally distinct from the toast to which they were supposed to be replying. That seems to have got to be a point of etiquette, on these occasions, which must not be transgressed. One excellent innovation desires mention and was introduced by Mr. Phillips, and that was the feeling way in which he referred to many who had passed away to their long rest within the past year or two, and whose smiling faces were sadly missed. It showed good feeling, and as one speaker said, it was pleasant to think that in after years when one might be called away to the happy hunting grounds—I was going to say clam fields,—their memory might be recalled on such occasions, and a toast quaffed to their memory. Mr. Phillips, proposed the toast of "Dear Departed Friends;" Mr. Ralph Pope replied to the toast of the "Telegraphers;" Mr. Lockwood responded to the "Telephone;" Mr. W. S. Key in an eloquent address responded for the "Electrical Press;" Mr. C. S. Sergeant for "Electric Power Transmission;" Capt. Wm. Brophy for "The Electric Light;" and then Mr. Lockwood proposed Mr. Phillips and the members of the American Electrical Works as "Jolly Good Fellows." Mr. Phillips in reply to the toast stated that he had given great thought to the development of the manufacture of electric wire, and had remained up at least one night thinking out many profound problems, and called upon his son who was present to stand up in corroboration of his father's statements. This the young man did, amidst the loud applause and laughter of the guests, after which they dispersed to wander about the grounds till it was time to again think of going home.

An unusually handsome souvenir was distributed this year, which was much prized by the recipients. It represented in silver, a basket of the succulent Rhode Island clam, full to the brim, and capped with a ripe ear of yellow corn. It makes a handsome paper weight, and we offer our sympathies to those who were not there to get one. This account cannot be concluded better than by the well chosen words on the back of the menu of this year:

"True philosophers, methinks,
Who love all sorts of natural beauties,
Should love good victuals and good drinks."

Thackeray.

"JUST THE THING FOR PRACTICAL MEN."

Mr. H. W. Jeamin, superintendent of the Jonesboro, Ark., Power Co. writes: You will find enclosed 60 cents for which please send me by return mail one of your morocco filing cases. I cannot express my appreciation in words for your enterprise in getting up those data sheets. It seems just the thing for practical men (such as myself), who are struggling under small salary to get a foothold in the field of electricity, who start in without a technical education, and learn what they can by dint of hard study and the expenditure of about all their means. I have found it very hard work and expensive to collect such data pertaining to my business in all of its details; viz., electric lighting. I take THE ELECTRICAL ENGINEER as well as several other technical papers. THE ELECTRICAL ENGINEER is my favorite, and I will always speak a word of praise for it whenever the opportunity offers.

THE CONSCIENTIOUS CLAIMS OF COLUMBUS, GEORGIA.

COLUMBUS, GEORGIA, is making an earnest and "conscientious" bid for the attention of the many visitors who will be attracted southward by the Atlanta Exposition, some of whom will keep a shrewd eye on the commercial possibilities of the New South. We have received a condensed folder, which is intended to give any one seeking a location in the South such information as he might desire. It gives the special advantages of Columbus, Ga., as a cotton manufacturing centre, and the inducements offered to those desiring to establish other industries there.

ELECTRICAL ACTIVITY IN CALIFORNIA.

The Oakland, Cal. *Enquirer* says: It is one sign of the times when an electric plant to cost $38,000 is contracted for in San Francisco. That will be the cost of the electric outfit of the Parrott building on Market street. According to Fresno advices, the dam across the San Joaquin river near Millerton, twenty-six miles from Fresno, will be completed during the present month and the machinery and appliances for the new electric power plant are said to be ready to put in. Poles are going up between Grass Valley and Nevada City for the Nevada Electric Power Company, and the Gold Hill mine will be operated by electricity. The Power Development Company of San Francisco, of which Charles Webb Howard is the president, expects to furnish at least 10,000 horse power from the water of the Kern river canyon, thirteen miles northeast of Bakersfield.

THE BALDWIN-WESTINGHOUSE PLANS.

So much misinformation, says the *Railroad Gazette*, has been published as to the purpose of the Baldwin-Westinghouse people that it may be worth while to say a little more explicitly what we have already said as to precisely what they intend to do. The first work to be done is to get up a set of designs for standard equipment. This will include motor trucks for light and for heavy service. Whether these trucks will be put under cars which will carry passengers, or baggage, or freight, or mere ballast, to give adhesion weight, will depend entirely upon the conditions in which they are used. This is a mere detail of construction. It is quite likely that in some cases the platforms under which such trucks are put will be covered over, to give the vehicle something of the appearance of electric locomotives, such as have already been built. It is quite possible, also, that this will not be done. The essential thing is to get up designs for trucks to carry the motors, which will be up to the best locomotive practice in economy of construction, safety of operation, and ease and economy of repair. When this equipment has been designed, doubtless one, or two, or three motor trucks will be built, and will be used experimentally. The companies have many requests for plans and estimates for electrical equipment of existing lines and of projected lines, and it is highly likely that they will have all they can do as soon as their standard equipment is thoroughly worked out. We have not learned, however, that they have been asked for designs for equipment for main lines of railroad, and feel sure that they would not encourage such an experiment.

THREE-PHASE APPARATUS IN POWDER MILLS.

The American Powder Co., at South Acton, Mass., have contracted for the building of a three-phase power plant, consisting of two 75 K. W. 550 volt generators, and eight 20 H. P., one 10 H. P. and three 5 H. P. induction motors all wound for similar voltage. The generators are to be driven by a combination of steam and water power. Water wheels driving from 100 to 150 H. P., and an engine supplying whatever may be required in excess of the capacity of the wheels up to 150 or 200 H. P. The motors will be placed at distances of about 800 feet to 2,600 feet from the generators, the line being practically continuous in one direction. The majority will be placed in a group at about 800 to 1,200 feet from the generator.

The motors will be housed in small brick buildings built for and adjacent to each powder mill, there being in no case more than one motor to a mill. These mills are all quite small, as each step in the powder making process is carried on in a different mill. The main shafting of each mill extends outside the mill proper and to this shafting the motors will be belted, running at an average speed of 110 to 120 revolutions. It will thus be seen that there is no motion in any mill except that necessary for the manufacture of powder. The equipment of these mills is directly due to the success which has attended the operation of two other mills of this company located in the West, which are operated by continuous motors and generators.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED AUG. 13, 1895.

Accumulators:—

Support for Electrical Batteries Used in Vehicles, T. Frogatt, London, Eng., 544,480. Filed May 1, 1895.

Alarms and Signals:—

Relay, T. B. Dixon, Henderson, Ky., 544,351. Filed Nov. 17, 1893.
Details of construction. Used in connection with a railway signal track instrument.

Thermostatic Instrument, M. Martin, Malden, Mass, 544,363. Filed June 5, 1893.
Details of construction, to keep dust from terminals.

Electromagnetic Signal, C. E. Scribner, Chicago, Ill., 544,387. Filed Jan. 8, 1895.
Two strips of soft iron placed within the centre of a solenoid are repelled at their ends when the solenoid is energised.

Conductors, Conduits and Insulators:—

Manufacture of Electric Cables, W. R. Patterson, Chicago, Ill., 544,372. Filed Aug. 24, 1891.
A machine for winding paper tape loosely on the wire.

Cleat for Holding Electric Wires, E. W. Buffington, Fall River, Mass., 544,501. Filed Mch. 15, 1895.

Apparatus for Insulating Wire, T. N. Hallanger, Chicago, Ill., 544,530. Filed Nov. 14, 1891.
Machine for carrying out process described in patent below.

Insulated Electric Conductors, T. N. Hallanger, Chicago, Ill., 544,531. Filed Feb. 18, 1893.
Each conductor is surrounded by a spirally wound tube, leaving an air space.

Dynamos and Motors:—

Commutator Connection for Dynamo Electric Machines, H. H. Wait, Chicago, Ill., 544,339. Filed Mch. 1, 1895.

Commutator Brush Holder, G. J. Junker, Mt. Vernon, Ill., 544,358. Filed Nov. 9, 1894.

Construction and Method of Operating Dynamo Electric Machines, F. H. Loveridge, Coldwater, Mich., 544,361. Filed Aug. 2, 1894.
The machine is adapted to deliver currents of various potentials simultaneously from the same commutator.

Winding for Dynamo Electric Machines or Motors, E. Thomson, Swampscott, Mass., 544,396. Filed Jan. 27, 1894.
A laminated core provided with projecting iron extensions between the coils, and having each single coil or circuit which generates or utilizes an alternating impulse, divided and interspersed between projections that occupy different positions around the structure.

Combination Dynamo, E. P. Warner, Chicago, Ill., 544,633. Filed Feb. 24, 1890.
A switch adapted to short circuit a portion of the field magnet coils to reduce the field strength, whereby the dynamo may be readily converted from a full arc to a half arc machine.

Electrometallurgy:—

Process of and Apparatus for Extracting Ores by Electrolysis, E. W. Clark, Butte, Mont., 544,610. Filed Nov. 5, 1894.
Places the positive and negative electrodes in separate chambers, one of which is a separating and the other an amalgamating chamber, provided with a channel or passage between them, within which channel is interposed a screen or filter, whereby the chlorine gas is generated in one compartment or chamber and the hydrogen gas and hydrate of soda in another.

Lamps and Appurtenances:—

Support for Incandescent Lights, C. A. Carmany, Middletown, Pa., 544,502. Filed Sept 8, 1894.

Electric Arc Lamp, R. H. Cunningham, Richmond, Va., 544,529. Filed Sept. 8, 1894.
The arrangement consists in the arrangement of the solenoids and their cores and the special devices connected therewith transmitting motion to the lamp-electrodes. Operates on the "differential" principle.

Electric Arc Lamp, J. H. J. Haines, New York, & A. B. Fernald, Jersey City, N. J., 544,578. Filed Nov. 20, 1894.
Similar to patent below.

Electric Arc Lamp, J. H. J. Haines, New York, & A. B. Fernald, Jersey City, N. J., 544,579. Filed Nov. 20, 1894.
A carbon carrier in the form of a screw and a nut rotated thereby, a moving support for said nut, by which it and the rod may be lifted, and means mounted upon said support for acting upon and controlling the rotation of the nut.

Measurement:—

Electromagnetic Damper for Measuring Instruments, E. P. Warner, Chicago, Ill., 544,332. Filed Sept. 13, 1894.

Miscellaneous:—

Tracker for Mechanical Musical Instruments, H. C. Reichardt, Pottsville, Pa., 544,332. Filed Dec. 18, 1894.

Synchronism Indicator, R. D. Mershon, Pittsburg, Pa., 544,365. Filed Nov. 12, 1894.
For description see page 175, this issue.

Electric Rheostat, F. B. Badt, Chicago, Ill., 544,278. Filed May 31, 1895.
The resistance coils are embedded in a plate of glass, the glass being molded about the conductor in the formation of the glass. The glass plate is clamped between a pair of ribbed cast iron plates.

Electric Wire Containing Hat or Cap Band, A. M. Rodrigues, Brooklyn, N. Y., and E. D. Rockwell, Bristol, C nn., 544,419. Filed June 10, 1895.

Electric Gas Lighter, E. Orling, Stockholm, Sweden, 544,514. Filed Feb. 5, 1895.
Adapted especially for Welsbach burners.

Electrotherapeutic Appliance, J. E. Wiles, Milwaukee, Wis., 544,552. Filed Jan. 14, 1895.
A multiple cell battery of tubular form.

Electric Lighting Attachment for Gas-Burners, F. A. Webb, Beverly, Mass, 544,634. Filed Mch. 11, 1895.
Means for electrically lighting Welsbach or Bunsen gas burners.

Railways and Appliances:

Conduit for Electric Conductors for Railways, F. L. Capps, Newark, N. J., 544,283. Filed Sept. 18, 1894.
Details of construction to secure high insulation.

System of Electrical Distribution, S. C. C. Currie, New York, 544,289. Filed Nov. 27, 1893.
For description see page 179, this issue.

Conductor for Electric Railways, P. C. Just, Chicago, Ill., 544,306. Filed Feb. 6, 1893.
A conductor so supported as to allow expansion and contraction under changes of temperature.

Trolley for Underground Electric Railways, M. D. Law, Washington, D. C., 544,312. Filed Jan. 31, 1894.

Traveling Contact Device for Electric Railways, J. C. Love, Philadelphia, Pa., 544,313. Filed Sept. 5, 1893.

Electric Railway Conduit System, L. H. Sherwood, Mt. Vernon, N. Y., 544,391. Filed Sept. 7, 1894.
The conductor is placed within a continuous tube, and thus protected from water entering from above.

Switches, Cut-Outs, etc.:—

Multiple Fuse Switch, J. Melzer, Saaz, Austria-Hungary, 544,318. Filed Oct. 20, 1893.

Strong Current Arrester, F. R. McBerty, Downer's Grove, Ill., 544,368. Filed May 31, 1894.
A spring is released by the melting of a fusible conductor.

Automatic Safety Appliance for Electric Conductors, A. E. Hutchins, Detroit, Mich., 544,496. Filed May 9, 1893.
Automatically shunts the main current to the ground as soon as the main line breaks or sags.

Telegraphs:—

Printing Telegraph, C. L. Buckingham, New York, 544,345. Filed April 16, 1894.
Relates to type-printing machines, and is designed more particularly to adapt said machines for printing typographical characters in page form at high speed upon sheets of paper.

Printing Telegraph, C. L. Buckingham, New York, and E. Germann, Brooklyn, N. Y., 544,346. Filed Jan. 10, 1895.
Details relating to the above.

Printing Telegraph, C. L. Buckingham, New York, and E. Germann, Brooklyn, N. Y., 544,347. Filed Jan. 10, 1895.
Details relating to the above.

Printing Telegraph, C. L. Buckingham, New York, and E Germann, Brooklyn, N. Y., 544,348. Filed May 20, 1895.
Details relating to the above.

Fountain Ink Roller for Telegraph Registers, C. A. Rolfe, Chicago, Ill., 544,644. Filed Oct. 13, 1894.
A "fountain" ink wheel for telegraph registers.

Telephones:—

Telephone Switch, F. R. Whitney, Lewiston, Me., 544,335. Filed June 30, 1894.
Details relating to a suspension hook.

Multiple Switchboard System, O. A. Bell, Brooklyn, N. Y, 544,341. Filed Feb. 21, 1893.
Details of construction by which the provision of a special clearing out annunciator is avoided and by which an operator at one section of the switchboard is enabled to determine whether any line is busy.

Plug and Cord for Telephone Switchboards, F. R. McBerty, Downer's Grove, Ill., 544,369. Filed Sept. 18, 1894.
Its object is to produce an improved form of a device for securely attaching the flexible conductor to the connecting plug.

Automatic Signaling Device for Telephone Switchboards, F. R. McBerty, Downer's Grove, Ill., 544,370. Filed Dec 26, 1894.

Electric Grounding Switch, C. E. Scribner, Chicago, Ill., 544,383. Filed Dec. 6, 1887.
Intended for telephone switchboards.

Single Cord Grounded-Circuit System for Multiple Switchboards, C. E. Scribner, Chicago, Ill., 544,384. Filed Dec. 1, 1890.

Test Signal for Multiple Switchboards, C. E. Scribner, Chicago, Ill., 544,385. Filed July 7, 1891.
Its object is to provide a simple and effective means for producing a signal in response to a current of proper character in the test circuit.

Telephone Switchboard Apparatus, C. E. Scribner, Chicago, Ill., 544,386. Filed Dec. 26, 1894.
The object is to facilitate the work of the operator in establishing connection between lines by automatically controlling the connection and disconnection of her telephone with the plug-circuit employed in uniting lines.

Telephone Exchange System, C. E. Scribner, Chicago, Ill., 544,388. Filed May 13, 1892.
A modification of the "law" system. The object is to simplify the apparatus employed in connecting between telephone lines at the exchange.

Signal Apparatus for Telephone Exchanges, J. J. O'Connell, Chicago, Ill., 544,545. Filed Apl. 17, 1893.
Provides a visual signal for the "busy" test, and a similar signal whereby the operator at the calling office is informed when the connection is made at the distant office.

Apparatus for Telephone Exchanges, J. J. O'Connell, Chicago, Ill., 544,546. Filed Apl. 17, 1893.
Relates to a visual "busy" signal.

Electrical Signaling Apparatus, W. W. Dean, St. Louis, Mo., 544,567. Filed Sept. 24, 1894.
A plurality of electromagnets operating a signaling device, with an interlocking means whereby the magnets may separately or conjointly control the signals. Applicable to the "common battery" telephone system.

ELECTRIC HEADLIGHTS FOR THE SOUTHERN PACIFIC RAILROAD.

Electric lights will soon succeed oil lamps as headlights on all of the passenger train locomotives of the Southern Pacific Company. The company has been experimenting with electric headlights for some time, and at last has perfected a light that can be operated by a dynamo on the engine, which will illuminate the track for a distance of 2,000 feet. Oil lamps light the track for only 200 feet ahead of the locomotive, and when running at a high speed engineers are frequently unable to stop, after observing an obstruction on the track, in time to prevent an accident. The Southern Pacific will be the first railroad company in the United States to equip all of its passenger train locomotives with electric headlights.

THE CANADIAN ELECTRIC FORGING AND SMELTING CO., LTD., has been organized in Canada with a capital stock of $500,000. The company has acquired the patent rights for the Burton liquid electric forging and smelting process for Canada. The offices are located at 42 York St., Toronto, Can.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE PARTZ ACID GRAVITY BATTERY.

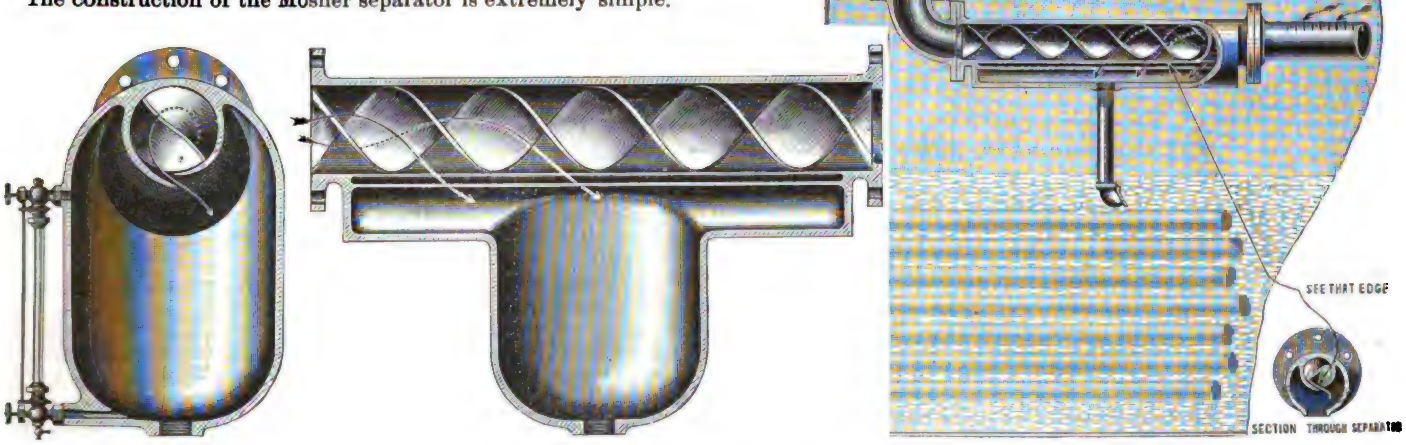
The S. S. White Dental Manufacturing Company has published a pamphlet in which the merits of the Partz "acid gravity" battery are set forth. The many applications of the battery are covered under the various heads: General purposes; physical laboratory and experimenting; coupled in various ways; for heavy bell work; as a substitute for sal-ammoniac cells; for physicians' office uses; on closed circuit; what feeding will do; for motor, etc., etc.

The results are also given of tests of the Partz batteries at the World's Columbian Exposition. The points of greatest importance practically demonstrated by these tests is the fact that when the electromotive force of the cells is apparently exhausted, the feeding in of a little sulpho-chromic salt restores them to full activity.

THE MOSHER STEAM SEPARATOR.

We illustrate in the accompanying engravings, the Mosher patent steam separator for separating all moisture from steam. The practical man will understand at a glance the principle of operation, which is the utilization of centrifugal force, acknowledged to be the only successful method of separation. The other important feature, and one which is found only in this separator, is that of at once isolating all water of separation from the current of steam, thereby rendering it impossible for any water to be again picked up and carried over to the engine.

The construction of the Mosher separator is extremely simple.



FIGS. 1, 2 AND 3.—THE MOSHER STEAM SEPARATOR.

As will be seen in Figs. 1 and 2, the steam conduit consists of a slightly enlarged section of the main steam pipe in which is located a worm or twisted plate. The wall of this conduit is of spiral form with one lip below the other, as is shown by the cross section Fig. 1, thus forming a slot through which all moisture is thrown to the collecting chamber below. Thus the steam is acted on many times in its passage around the twisted plate and the heavier particles being thrown outwardly by centrifugal force are shaved off and deposited in the isolated chamber below. From which it may be returned to the boiler.

The Mosher separator is also made with small collecting chamber, rendering it more compact and adapted to places where other styles would be excluded on account of limited space. The compact style is peculiary adapted to many other uses, among which is the extraction of oil from exhaust steam, rendering a considerable saving in oil and in destruction of roofs; on exhaust pipes when steam is used for heating purposes, to keep pipes and radiators from becoming clogged with oil and rendering them inefficient; between cylinders of compound engines to extract water of condensation; between low pressure cylinder and condenser to avoid the clogging up of condenser by oil from cylinders; also in ice and refrigeration plants to extract the oil from ammonia gas, thus providing against pipes becoming coated on the inside by oil in cylinder lubrication, which renders them very inefficient. In the last named capacity the Mosher separator is the only device that has successfully accomplished this extremely difficult problem of separation.

Many boilers are subject to violent priming or foaming during which a considerable amount of water is carried out of the boiler. In such cases the trouble may be entirely avoided by the introduction of a Mosher separator inside the boiler, as shown in Fig. 3. The separator, which by reason of its small size may be introduced through the ordinary manhole and connected between throttle and a perforated dry pipe will prevent any possibility of wet steam leaving the boiler due to primage and therefore furnish dry steam at all times regardless of how severe the boiler may "foam" or "prime."

The Mosher separator is built in sizes from one and one half inches to any size required. The larger sizes are constructed of steel castings or boiler plate when so desired and will withstand any desired pressure. Separators are tested for two hundred pounds working pressure per square inch. These separators are built by Charles D. Mosher, No. 1 Broadway, New York, who will be pleased to send his "Treatise on The Steam Separator" to all who desire it.

THE GRAND AVENUE ELECTRIC WORKS, KANSAS CITY, MO.

An item in a recent issue may have given the impression that the Grand Avenue Electrical Works, of Kansas City, Mo., were a branch of the Standard Telephone Company, of Wisconsin. We are requested to state that such is not the case, but that the Standard Company is promoting a telephone exchange with the aid of the Grand Avenue Company, and is meeting with considerable encouragement among telephone users.

AN "IDEAL" ENGINE ROOM.

We have received from the Harrisburg Foundry and Machine Works, Harrisburg, Pa., a pamphlet containing press notices of the up to-date engine room at Keith's New Theatre, Boston, on which no care or expense seems to have been spared. This room is supplied with 3 Harrisburg Foundry and Machine Company's Ideal Engines, 15½ x 14" cylinder, which give an aggregate of 525 horse-power. They are used to run 6,000 16 candle-power lights, at 110 volts. The engines run at 270 revolutions, and are practically noiseless. The finish of the machinery is excellent, the trimmings all being of the best nickel plate.

6,000 H. P. OF HARRISBURG IDE AND IDEAL ENGINES.

W. R. Fleming & Co., representing the Harrisburg Foundry and Machine Works, Harrisburg, Pa., report the following list of Ide and Ideal engines as recent sales made through their offices in New York, Boston, and Philadelphia, exclusive of sales outside of these territories.

1-160 H. P. direct connected to Siemens-Halske dynamo for Hotel "San Remo," N. Y.; 1-50 H. P., direct connected to General Electric dynamo, for N. Y. Life Ins. Co., N. Y.; 3 150 H. P., direct connected to Crocker-Wheeler dynamos for Hotel "Walton," Philadelphia; 2-50 H. P., direct connected to General Electric dynamos for Fahys Building, N. Y.; 3-50 H. P., direct connected to Eickemeyer dynamos for elevator service, Fahys Building, N. Y.; 1-150 H. P., tandem compound engine to S. O. & Co., Ansonia, Ct.; 1-80 H. P. and 1-120 H. P., direct connected to General Electric dynamos for Germania Life Ins. Building, N. Y.; 2-80 H. P., direct connected to General Electric dynamos for Hotel "Stenton," Philadelphia; 1-40 H. P. and 1-60 H. P. for W. H. Hayden, Bath, Me.; 1-25 H. P. to Brigham Electric Co., Boston; 2-400 H. P., direct connected to General Electric railway generators for export to Rio Janeiro; 1-30 H. P. for Columbia Spinning Co., New Bedford, Mass.; 1-20 H. P. for new City Hall, Brockton, Mass.; 1-300 H. P. tandem compound Ide for export So. Africa; 1-75 H. P. Ide for American Surety Bldg., N. Y.; 2-750 H. P. tandem compound railway engines, Ide, direct connected to General Electric dynamos for Philadelphia, Castle Rock & Westchester R. R. Co., Philadelphia;

2-80 H. P., direct connected General Electric dynamos to Bar Association Bldg., N. Y.; 2-50 H. P., direct connected to dynamos, Lorsch Bldg., N. Y.; 3-125 H. P. Harrisburg tubular boilers, and complete steam construction for Custom House, N. Y.; 2-200 H. P. tandem compound engines and 1-40 H. P. simple engine for magnificent new Hotel Royal, Poinciana, Fla.; 1-100 H. P. to Larchmont Elec. Co., Mamaroneck, N. Y.; 1-60 H. P. for "Mail & Express" Building, N. Y.; 1-25 H. P. engine and 1-25 H. P. Harrisburg boiler for General Electric Co., Foreign Dept., Schenectady, N. Y.; 1-15 H. P. Manhattan Ry. Co., N. Y. City; 3-125 H. P., direct connected to Siemens-Halske dynamos for apartment house, 75th St. and Columbus Ave., N. Y.

RECENT CHLORIDE ACCUMULATOR INSTALLATIONS.

A BATTERY of Chloride accumulators manufactured by the Electric Storage Battery Co. of Philadelphia, having a capacity of 216 K. W. hours, has been sold to the Argentine Republic for furnishing light and power in one of the Government Buildings in Buenos Ayres. A contract has also been closed with the German Liederkranz Society of New York City for a lighting battery with a capacity of 182 K. W. hours. The Western Union Telegraph Co. is installing at Washington, D. C. under the supervision of its Asst. Electrical Engineer, Mr. G. W. Gardanier, 796 Chloride accumulator elements of various sizes.

THE HOGAN BOILER COMPANY'S "PROOFS."

"PROOFS" a pamphlet published by the Hogan Boiler Company, Middletown, N. Y., shows in detail the advantages of the Hogan stationary and marine water tube boilers, which it makes in twenty-four sizes, in units of 75 H. P. to 800 H. P. Tables are given showing extra first cost of materials and appliances, and average extra floor space necessary and extra first costs, in steam plants varying from 1,000 to 10,000 horse power ordinarily necessary. Under all these heads a twenty per cent. greater efficiency is shown for the Hogan boiler, with a great economy in fuel.

THE MASSACHUSETTS FAN CO.

The business of The Davidson Ventilating Fan Company has been acquired by the Massachusetts Fan Company, with offices at 41 Federal St., Boston, Mass. The Davidson fan will be manufactured and sold by the new company. A large stock of fans is now being made up, and orders of any size can be filled without delay.

BRANCH OFFICES OF THE ELECTRIC STORAGE BATTERY CO.

IN order to meet the growing demand for its products, the Electric Storage Battery Company has opened branch offices at 383 Exchange Building, Boston; 309 Dearborn St., Chicago; 15 First St., San Francisco; 215 North Calvert St., Baltimore; and 66 Broadway, New York. The office of the Electric Launch Company will be at Morris Heights, New York City.

THE ELECTRICAL MAINTENANCE COMPANY.

THE ELECTRICAL MAINTENANCE CO., 50 Broadway, New York, is doing an active business in inspecting and keeping in repair electric machinery of all kinds—dynamos, motors, electric elevators, switchboards, storage batteries, etc., etc. It holds itself liable to replace burned-out armatures, field coils, commutators and brushes, and other portions of the electrical machinery damaged otherwise than by ordinary wear and tear, at a yearly contract price, which is a fixed charge to customers, entirely releasing them from the responsibility of the successful working of their electrical plants.

This company has now made permanent arrangements with Messrs. A. K. Warren & Co., the largest and best equipped electrical repair shop (official repair shop of the General Electric Company) in the country, to do its heavy repairing. All inspections are made from this office by its experts regularly, and a report of the inspection is mailed monthly.

A BARGAIN IN BIG ENGINES.

OWING to the recent consolidation of the Edison and the Citizens' Companies in Brooklyn and a redistribution of the station loads, the two magnificent engines installed recently in the Citizens' Electric Light Co.'s station, are to be dispensed with and are now offered at a bargain by Paul T. Kenny, 126 Liberty St., New York. The following is a description of the engines:

McIntosh & Seymour vertical four cylinder, triple expansion, automatic engines; size of cylinders, 18 x 24, 21 x 24, 23 x 24; R. P. M., 155: steam pressure, 150; and horse power of each 400. The cylinders are provided with the regular McIntosh & Seymour double valve arrangement. The main driving wheel between cylinders is 11', 6" in diameter and 48" face, weight 16,000 lbs. The engines have shaft governor and overhanging cranks, and are fitted with oil tanks, sight feed outlets and oiling devices complete. A cut of the engines is shown on page xviii of the advertisements in this issue.

CONTRACTS AWARDED FOR THE NEW WILKES BARRE, PA. ELECTRIC LIGHT STATION.

THE WILKES BARRE ELECTRIC LIGHT CO., for whom Mr. J. H. Vail is acting as supervising engineer, has awarded the following contracts: Boilers, 900 H. P., to the Stirling Boiler Co.; engines, 400 H. P. Armington & Sims engines, to E. P. Hampson & Co., general agents; stack, steel plate, brick lined, self-supporting stack, to Riter & Conley, Pittsburgh, Pa.; pumps, vertical, deep well pumps, to H. R. Worthington & Co.; iron roof structure and other iron work, to N. J. Steel & Iron Co., Trenton, N. J.; shafting and friction clutch pulleys, to Falls Rivet & Machine Co., Cuyahoga Falls, O.; traveling crane, to Maris Bros., Philadelphia, Pa.; heaters, to Warren Webster & Co., Philadelphia, Pa.

THE PEERLESS RUBBER MANUFACTURING COMPANY.

We have received a catalogue and price lists of the Peerless Rubber Manufacturing Co., 16 Warren street, New York, in which the many branches of their wide range of rubber and other goods are treated in detail. The catalogue extends to 72 pages, and forms a useful guide to those on the lookout for reliable forms of packing, gasket, steam hose, rubber and leather belting, matting, pads and miscellaneous rubber goods.

BIDS WANTED.

MR. LOUIS R. SCHULTZ has been retained as consulting engineer for R. J. Thompson & Co., cor. 11th and Chestnut Sts., Philadelphia. He is receiving proposals up to Aug. 23 for a 200 H. P. lighting and power plant. Direct connected dynamos will be used.

WESTERN NOTES.

THE DALTON & LARK MINING CO., of Bingham, Utah, have recently put in a 100-light Dayton dynamo, to light their shafts, mines and building. The plant was installed by R. W. Nicol of Salt Lake City.

THE METROPOLITAN ELECTRIC COMPANY, Chicago, has secured the Western Agency for the "Ship" cored carbons. These carbons are imported from Vienna, Austria. They have already established an enviable record, and as the Metropolitan Company has placed a large stock order, they will be able to fill all orders for imported carbons promptly.

THE FRANKLIN ELECTRIC CO., of Miamisburg, O., announce that they have bought the entire business and good will of the Franklin Electric Co. formerly of Cincinnati, O. and will continue the manufacture of battery motors of all sizes, electric alarm clocks, etc. They will also handle a full line of students' and experimenters' supplies, such as castings and parts of dynamos, motors, steam and gas engines, either partly finished or in the rough. They will strive to furnish anything the young electrician, student, or experimenter may want, and at lowest prices.

LAMPASAS, TEXAS.—The Lampasas Electric Light Co. has been organized with a capital stock of $20,000. Its officers are: J. T. Donovan, president; J. C. Matthews, vice-president; W. H. Browning, secretary and treasurer; and E. A. Maxwell, manager. It has 14 miles of Okonite wire circuit, and operates from one Heisler 800 light machine, and one Jenney of 800. Water power is used, the wheel being a 93 H. P. Leffel. The company is in the market for arc lamps for their Heisler system, 2,000 C. P., 5 amp., series, ½ inch carbon. The power house is of stone. There is a fine opening in the neighborhood for power transmission. From the Colorado River, 15 miles distant, 1,600 H. P. could be taken. This, transmitted to Lampasas, could run all the street cars, gins, and cotton mills in the city.

NEW YORK NOTES.

THE Perkins Electric Switch Mfg. Co., of Hartford, Conn., through their New York representative, Mr. C. I. Hills, have sold 50 Waterhouse-Gamble ornamental arc lamps, to be installed in the new dry goods store of M. C. Spencer & Co., on 125th St., New York.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

Vol. XX. AUGUST 28, 1895. No. 382.

THE GROWTH OF LONG DISTANCE COMMERCIAL TELEPHONY.

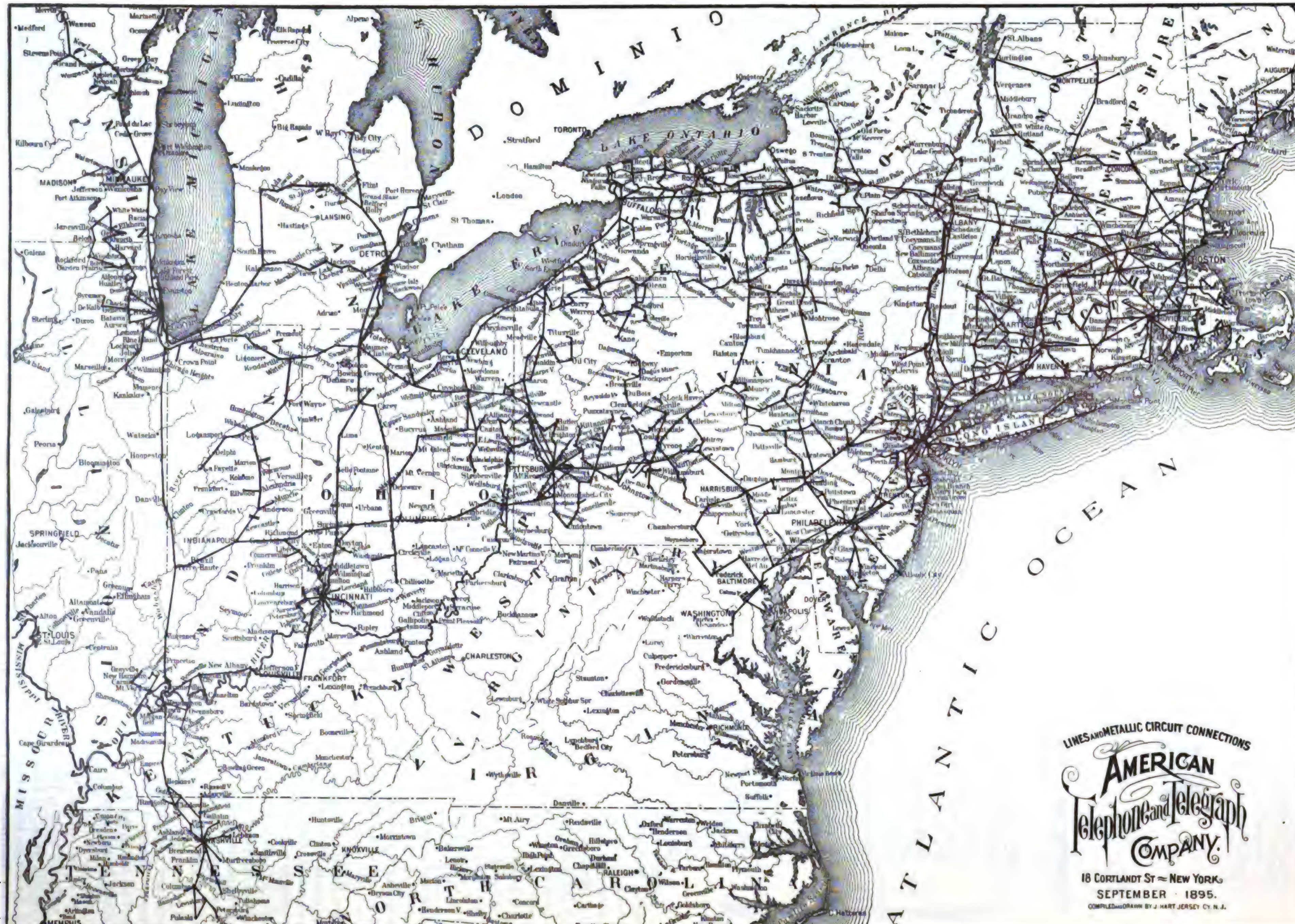
THE last report of President Hudson of the American Bell Telephone Company stated that the total investment in telephone property in this country at the close of 1894 was $77,500,000. It would appear that no less than 10 per cent. of this large sum is represented distinctively in what is known as the "long distance" service as organized and developed by the American Telephone and Telegraph Company. This corporation, known in popular parlance as the Long Distance Company, had invested up to the end of 1894 in line construction, equipment and supplies the amount of $7,460,662, upon which the 1894 gross earnings were $1,011,961, an increase over 1893 of nearly 13½ per cent. Such figures would in themselves indicate the rapid development within the last five years of the long distance telephone system, for it is within that period that the greatest strides have been made. The first line was constructed by the American Telephone and Telegraph Co., which was, as everybody knows, specially organized by Bell interests for this particular work. It dates back to 1885, and then extended merely between New York and Philadelphia. The system to-day includes 55,000 miles of pole line and 265,000 miles of wire, all of the very latest and best type of construction. Between such cities as New York and Boston and Philadelphia, there are as many as 40 wires in the line. The physical and numerous other details of the system were fully set forth in THE ELECTRICAL ENGINEER of May 4 and 11, 1892, by Mr. Herbert Laws Webb, and of Dec. 14, 1892, by Mr. Joseph Wetzler. It will therefore suffice to mention here that the standard size of wire employed has been No. 12 B. S. G.—.104 inch diameter—of hard drawn copper, having a resistance of 5.2 ohms to the mile; the poles being 40 footers with 130 feet length of intermediate span.

From the development of this system in 1885, down to the present time, the work of extension has been carried on, unhasting but unresting, so that it now has grown into the gigantic network shown in the map to be issued by the American Telephone & Telegraph Co. next month, and presented on page 198 of this issue. This map of which we are thus enabled to present an advance proof has many features of significance. East of the Hudson River, and including the whole New England region the system is already strongly interlaced, and, when the local exchange systems are considered, leaves very few vacant patches of territory. Around Philadelphia again the lines are dense, but not so much so as in Buffalo and Pittsburgh; while Cleveland is apparently limited still in its "long distance" resources. Part of Michigan is untouched, and although Chicago is, of course, the centre of a cobweb of wires as it is of railroad tracks, the service northward to Milwaukee and Merrill, Wis., is slimmer. Going south, Cincinnati is found to be an important nucleus, but between the Ohio River and Baltimore, on Chesapeake Bay, the country is still a blank, speaking from the "long distance" standpoint. Directly southward from Cincinnati the lines run to Louisville, and thence with strategic slants and twists to Nashville, Tenn., and far away again to Shelbyville, Fayetteville and Pulaski. It will be observed that from Chicago to Terre Haute, the line parallels the Indiana State border, leaving bare all the territory westward; but it is a fact that that region is being rapidly filled in and occupied and that the material is already deposited in St. Louis for the next big section of work.

All over the sections completed the talking is remarkably good. The present writer has frequently conversed with New York from points as remote as Chicago and Milwaukee, and has had perfect results, even in the wet months of October and November. It will be remembered moreover as one of the incidents of the memorable blizzard of 1889 that the only direct interchange of news between New York and points outside was had by means of the long distance wires; and that while telegrams between New York and Boston were necessarily sent via Ireland, over the Atlantic cable, people in their New York and Boston offices were quietly chatting over the telephone as though nothing had happened.

The American Telephone and Telegraph Company now issues a list of over 2,000 places connected by metallic circuit—*i. e.* two wires for each station—with the Long Distance system, but even this does not give an idea of the work of this character now being done, for the reason that it does not include the local exchange groups of cities still to be brought within the service and already enjoying intercommunication over lines 300 and 400 miles long. Cities like Minneapolis, St. Louis, New Orleans, Kansas City, Omaha, Denver, Salt Lake City, Portland, Los Angeles, Fort Worth, Galveston, Mobile, Atlanta, are all the foci of separate systems, well developed, and only awaiting the course of events to be assimilated with and joined into the regular Long Distance network. In the Southern States these local exchanges and their extra-territorial lines are so well recognized as ready for blending that for months past a rumor has been in persistent circulation to the effect that should competition at various points become severe, the interconnected lines between cities would be thrown open free to the subscribers who stood by the local Bell exchanges.

This brings us, first, to the question of rates. The schedule of rates for five minutes' talk from New York subscribers' own stations and from the 1200 pay stations scattered all over the city appears at first sight to be extremely high, and must undoubtedly be radically reduced as time goes by; but when it is considered that an ordinary man can easily talk 150 words in a minute, $9 for 750 words to Chicago, with interlocutory responses, in the day time, is not so much out of the way, as compared with telegraphy; while the night rate of $4.50 for the same quantity is more reasonable still. Besides this, there is now in vogue a system of sending out from the nearest pay station for the person wanted, if not a subscriber, and, without extra charge, bringing him in for the desired communication. A scale of commutation rates also exists, averaging 15 and 20 per cent. on a certain bulk of business. Be the rate high or low, it has for some time past



Official Map to be Issued September 1, of the Long Distance Telephone System in the United States—Circuits Shown in Heavy Black Line.

been asserted that the growing use of the Long Distance lines has seriously affected through railway travel and interfered with hotel patronage in the large cities.

It is interesting in this connection to recall the fact that prior to the extensive telegraph consolidations in 1866, the telegraph rate from New York to Chicago for only 10 words was $2.05 with 15 cents for each additional word; while to Portland, Ore., it was $10.20 and 77 cents per extra word. The rate to Chicago to-day seems infinitely smaller, and yet it is dearer than that charged for the long distance telephone, unless a special rate were obtained for so long a message as 750 words. The elements of direct intercourse and of immediate access may be left wholly out of account, and the advantage would still seem to rest with the telephone even at its undeniably high tariff.

The expansion of this long distance telephone service has therefore already marked a distinct limitation for the telegraph between cities, and in some quarters the complete supercession of the telegraph is looked for, although Mr. P. B. Delany has suggested, with wonted fertility, that the telegraph lines be hereafter devoted to the instantaneous transmission of the mails. The relations between the American Bell Telephone Company and the Western Union Company have since 1879 been determined by a contract which in this issue of The Electrical Engineer is for the first time made public, and which should apparently expire next year. As this contract shows, the telephone has during this period paid to the telegraph a commission of 20 per cent. on its gross rental income for the privilege of doing business free from vexing competition; but the question has of late assumed shape as to whether the telegraph has not in a sense been selling its birthright for a mess of pottage. Some of the daily newspapers have assumed that the state of affairs betokens irrepressible and inevitable conflict, with an utter disuse of the telegraph in the long run. As a matter of fact, no electrical appliance has ever yet completely given way before another; it has merely found its more legitimate sphere of strictly profitable use; while dealers in electrical supplies report that the recent great increase in the number of private telephone lines has been accompanied by a very brisk demand for telegraph instruments to be switched in and out of circuit. Combination of telegraphy and telephony over the same wire may yet be seen to be commercially feasible, and it is to be borne in mind that the new copper circuits of the Western Union and Postal Telegraph Companies could well do some independent telephonic work if it were advisable. Be this as it may, there are many indications that the habit of telegraphing does not gain ground, while the practice of telephonic intercourse grows at an extravagant rate. The average of about one telegraph message per year per head of population appears to be steady in this country, but in the cities it now falls below that, showing the limiting effect of the telephone, assisted by the district messengers. Even in England, the ratio is only two messages per head. Hence, also, there would appear to be little inducement for the telephone companies to try duplex telegraphy on their circuits. Of late years extremely little has been heard in this country of the combined telegraphic and telephonic systems with which the names of Van Rysselberghe and Rosebrugh have more particularly been connected. The reason may be that in telephony as in telegraphy, the apparatus steadily and all the time tends away from complexity and back to pristine simplicity. Telegraphers all swear by Morse, and everbody makes and uses the early Bell receiver.

The amount paid by the American Bell Telephone Company to the Western Union Telegraph Company has now reached substantial figures. The earlier statistics are not easily obtainable, but the item of "Commission" in 1883-4 ran as high as $354,856, while in ten months of 1884, when the American Bell financial year was changed, it reached $325,207. The subsequent years run as follows:

COMMISSION.

Year.	Amount.
1885	$396,650
1886	404,111
1887	433,578
1888	467,471
1889	511,215
1890	575,221
1891	614,019
1892	648,689
1893	690,380
1894	459,958
	$5,201,292

If to this sum we add $300,000 per year for the five years preceding 1885, and $500,000 for 1895, we reach a truly grand total of $7,250,000, which, according to this "Commission Account," has gone into the pocket of the Western Union Telegraph Company in about fifteen years, as the consideration for which it agreed to sit still and do nothing in telephony.

PHOSPHORESCENCE.

In a Note in a recent number of the *Comptes Rendus*, M. Gaston Séguy gives the result of some experiments made by him with regard to phosphorescence in electric discharge tubes. As is well known, the phenomenon of phosphorescence is observed in tubes containing rarefied oxygen through which an electric discharge has been passed. In the course of numerous experiments on nitrogen and its components, M. Séguy finds that nitrogen also phosphoresces, at least in the presence of a metallic bichloride. The tube used by M. Séguy consisted of three bulbs, fused together and furnished with electrodes. These were filled with nitrogen obtained from atmospheric air by the Brin process, a vacuum being then made, and the vapor of bichloride of tin being added. If an electric discharge is passed, the tube glows brilliantly, and the glow persists after the interruption of the current. The glow is a reddish color during the discharge, whilst that of an oxygen tube is a grayish violet. The phosphorescence is a milky white, filling the whole tube with the exception of a few centimetres near the poles. This glow attains a maximum brilliancy immediately after the interruption of the current, and gradually disappears at the end of 10 sec. or more.

METHOD OF MEASURING ELECTRIC CAPACITIES.

Mr. H. Bordier, in a paper read before the Académie des Sciences, decribes a method of measuring electrical capacities, based upon an experiment by Prof. D'Arsonval. If condensers of increasing capacity are placed successively in series on the same induction coil, and if, either by the aid of a rheostat or by moving the coil by predetermined steps, the moment is found determined in which the least sensation produced by the current on the skin is perceived, it is found that this moment varies for each added capacity. With a microfarad divided into tenths, it is stated to be easy to find two positions either of the rheostat or of the coil which correspond to the initial sensations produced by each tenth of microfarad added. The method allows a very approximate measurement of the capacity of the body of man to be obtained. The results showed:—First experiment, 0.002 microfarad; second experiment, 0.003 microfarad; average value, 0.0025 microfarad. This capacity is about 58 times greater than that of a homogeneous conductor, the surface of which would be equal to that of the human body. It is suggested that this capacity, relatively large, of the human body is due to phenomena of condensation occurring in the heart of the organism.

RESEARCHES ON THE ELECTRIC DISCHARGE OF THE TORPEDO.[1]

(Lighting Lamps and Geissler Tubes.)

BY A. D'ARSONVAL.

As I have maintained for several years past, the muscular contraction and the discharge of the electric organ seem to me to be assignable to the same cause, namely: the variations of surface tension, that is, the same principle which is embodied in the capillary electrometer of M. Lippmann. The discharge of the electric organ is but an exaggeration of the electric oscillation which is observed in the muscle when it contracts.

In order to register the phases of the discharge of the torpedo, I employed a special instrument called a galvanograph, consisting essentially of a very light coil of aluminum, over which is wound the circuit through which the discharge passes. This bobbin is fixed to the centre of a rubber diaphragm tightly stretched on a Marey air drum. The movable coil is placed in a strong magnetic field, the movements of the first drum being transmitted to a second one, which amplifies the motion, and carries a registering lever, which marks on the surface of a smoked cylinder. For the registering of the strength of the current a stretched silver wire was employed, the elongation of which, due to the heating effect of the current, was registered on a cylinder.

In order to take a measurement, the torpedo is placed on a cast metal plate, holding a layer of sea water of one centimeter depth so that the animal can breathe during the experiment. Out of sheet tin foil there are cut two electrodes having the form of the electric organs, and these two sheets are applied to the dorsal surface of these organs, and joined together by a band of tin-foil of 5 centimetres width, and fairly thick. The lower metallic plate on which the fish rests constitutes the negative electrode and the sheets of tin foil the positive electrode of this living electric generator. These are the electrodes which are connected to the different apparatus designed to measure or to render visible the discharge of the organs.

In order to provoke the discharge it suffices to pinch even lightly the edge of the fins of the fish with a pair of dissecting tweezers. Under these conditions the torpedo in general gives but a single discharge, but if the pinching is violent the discharges are multiple, and troublesome to register.

The curve inscribed by the galvanograph shows that the discharge is not continuous. It consists of 6 to 10 successive discharges, which increase from the beginning and follow one another at periods of $\frac{1}{100}$ of a second. The intensity attains its maximum in general after the third discharge, and then gradually diminishes to zero. The current always passes in the same direction, the back of the animal always being positive and the belly always negative. The curve resembles absolutely that of muscular contraction, the intensity increasing rapidly to a maximum and then falling to zero more slowly.

The mean duration of the discharge varies between $\frac{1}{10}$ and $\frac{5}{100}$ of a second, at a temperature of 19 degrees C. On torpedoes of 10 to 14 inches in diameter, kept for eight days in the basins of the laboratory, I obtained the following data: Electromotive force varies between 8 and 17 volts, and the current strength between 1 and 7 amperes. In possession of these data, I have thought that it was possible to bring before the eyes of the public the energy of the discharge under a more tangible form. For this purpose I employed the following arrangement, which succeeded very well. I took an incandescent lamp, requiring 4 volts and 1 ampere, and connected it to one of the electric organs. On pinching the animal, this lamp lights up and maintains a white heat for an instant. It is prudent to put the lamp in connection with only one of the organs, and to pinch the animal lightly, otherwise the lamp is invariably burned out, as happened to me the first time that I made the experiment. I have been able to put three to six lamps in series and bring them to a white heat. I have likewise succeeded when placing them in parallel. Not having a larger number of lamps at my disposal I was limited in my experiments which demonstrated in a sufficiently exact manner the correctness of the results obtained with the registering apparatus. With the Deprez-Carpentier amperemeter, having a range of 5 amperes, the needle was thrown far beyond the scale. By throwing the discharge into a small Ruhmkorff I have also succeeded in brightly illuminating two Geissler tubes. The two organs act synergetically, and with the same intensity, as can be readily demonstrated by placing an electric lamp on each organ. The two lamps light at the same instant, and reach the same brightness, although the circuits are separate.

The organ becomes exhausted quickly; after 4 or 5 discharges, repeated one right after the other, the lamp burns more and more feebly. If one has employed the current of but one organ, and then carries the lamp to the second organ, which has remained on open circuit, one obtains a current which will light up the lamp brightly. This fact proves that the voluntary nervous incitation does not suffice to exhaust the organ, and that it is in the organ itself and not in the nervous system that the electricity is produced. Five or ten minutes of rest brings up the discharge to its original strength, if light pinching has been employed.

By inserting two thermo-electric needles into the organs I have observed that during the discharge the organ heats up from $\frac{2}{10}$ to $\frac{3}{10}$ of a degree; but only when short circuited on itself. On open circuit I have not observed any heating, notwithstanding repeated pinchings.

By placing on the organ a stethoscope during the discharge I have been able to perceive a low sound corresponding to about 100 vibrations per second, showing that the organ is the seat of vibrations, such as those which take place in the muscles during voluntary contraction. I have also observed a retardation in the discharges between the anterior and the posterior part of the same organ, amounting to $\frac{4}{100}$ of a second. Is it possible that the organ consists of separate parts having independent discharges?

Finally, I have not observed any difference of potential between the two faces of the organ when in repose. This difference only shows itself at the moment that the animal throws out voluntarily its discharge.

I am pursuing these researches, and I shall make known shortly to the Academy the influence which the principal physical agents and various poisons exercise on the nerves and muscles. It will then be simple to show you the physical theory of animal electrogenesis which I have proposed and to explain all the phenomena previously known, and which led me to discover these new ones.

1. Abstract of a communication to the French Academy of Sciences.

THE HORSE POWER OF A LIGHTNING STROKE.

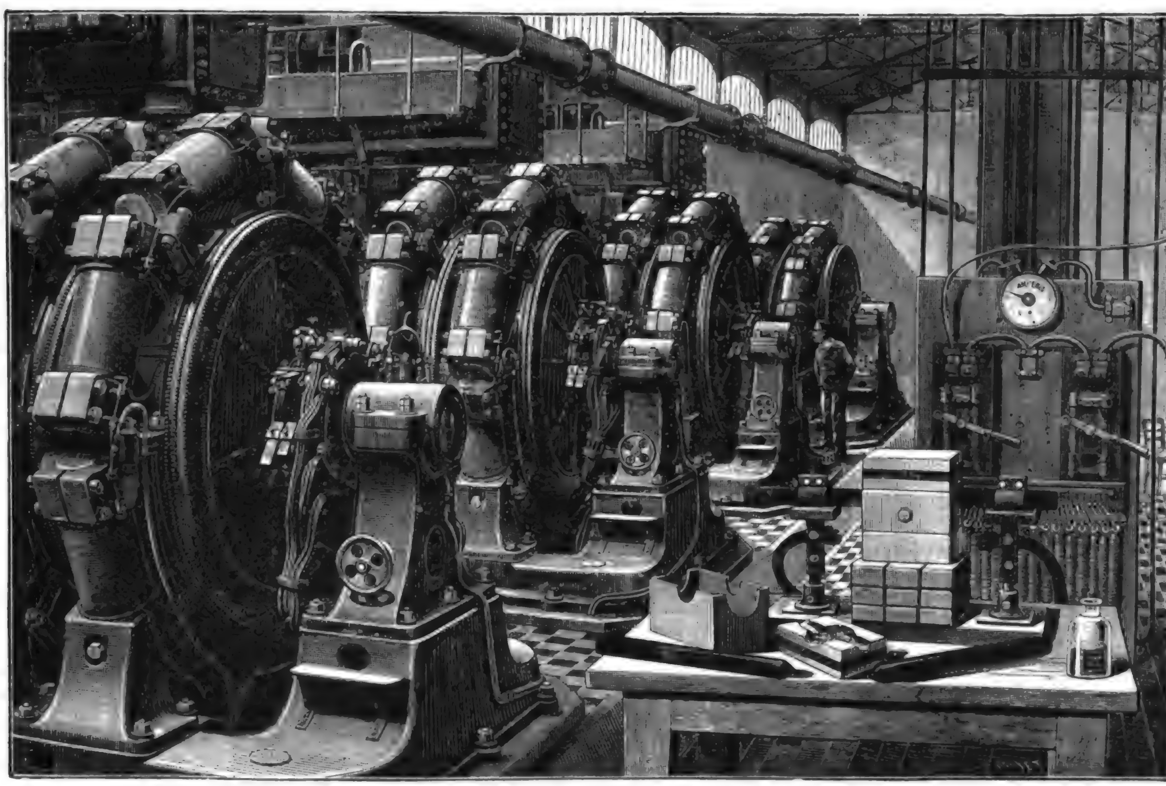
In a recent issue of the *Archiv für Post und Telegraphie* Prof. Hoppe gives some interesting details of the energy developed by a lightning stroke. At Klausthal a lightning stroke struck the wooden post of a house and fused two nails 4mm. thick. Experiments made afterwards by Messrs. Siemens and Halske, of Berlin, showed that a current of 200 amperes and 20,000 volts was required to do this work in one second. This represents about 7,000 H. P., and taking the duration of the lightning as one-tenth of a second the total power would be ten times as much.

THE ELECTRIC FURNACE AND CHEMISTRY AT HIGH TEMPERATURE.[1]

BY H. MOISSAN.

THE reverberatory electric furnace with movable electrodes which we built in 1892, and successfully improved since that time, is of great simplicity. By means of this apparatus we have been able, thanks to a sufficiently high temperature, to reproduce diamonds, to effect crystallization of the metallic oxides, the reduction of oxides heretofore deemed irreducible, the fusion of refractory metals, the distillation of lime, silicon, zirconium and of carbon, and finally the abundant vaporization of metals, such as platinum, copper, gold, iron, manganese, aluminum and uranium. The operation of our apparatus is of the most simple character. The current is carried by two flexible cables to the carbon electrodes. The contact is established, the arc starts and, by withdrawing the electrodes more or less, this powerful spark is given a constant length which depends on the power of the current, and on the conductivity of the metallic vapors which fill the furnace.

From the beginning of the experiment a penetrating odor of hydrocyanic acid is produced, brought about by the combination of the nitrogen in the furnace, with the acetylene which is formed at the beginning. This is an energetic reproduction of the beautiful synthesis of hydrocyanic acid obtained by M. Berthelot. A purple cyanogen flame first illuminates the arc; then this color disappears and the light becomes white. The lime which forms the interior of the furnace soon begins to melt and to run like wax, and then to boil, and in a few minutes the electrodes are brought to red heat, a torrent of vapor issuing from all sides with a constantly increasing intensity. The lime distills in abundance, and covers the supports of the electrodes with a white film. Thus, when utilizing the current of a machine of from 100 to 300 H. P. we have in the middle of the furnace an enormous temperature, produced by the electric arc; a few centimetres below, the crucible which encloses the matter experimented on; and below this, a wall of lime in full ebullition. The bad conductivity of this lime is a fortunate thing for us. It confines in the smallest possible cavity the maximum heat which an electric arc can give us.



THE MOISSAN ELECTRIC FURNACE IN THE EDISON STATION, PARIS.

This new apparatus, which we have modified according to the requirements of experience, has permitted us to undertake the study of a whole series of simple bodies, which heretofore have been only laboratory curiosities, for the lack of sufficient means to obtain them. Among these substances is chromium, which has never heretofore been obtained in any large quantities. In order to obtain chrome steel it was necessary to prepare in a cupola an alloy of iron and chrome very rich in carbon, and known as ferro-chrome. With an electric furnace an abundance of cast chrome is obtained, by reducing the sesquioxide by means of carbon. This cast product, when refined, gives us the chromium, and this inoxidizable metal is very different from that heretofore obtained. It takes a finish like iron, and a very beautiful polish. In one experiment forty-four pounds of chromium were obtained at one casting. Molybdenum can also be obtained in the same way in large quantities. Combined with steel it takes a temper, and can be forged under the anvil at red heat.

Tungsten was a substance formerly known to chemists only in a state of powder; its preparation in the electric furnace will become very simple. Under the action of the arc the oxide of tungsten will be reduced by the carbon and will give us in a few minutes a pure metallic mass, covered with a beautiful layer of blue oxide of tungsten. The tungsten does not seem to have a great affinity for carbon, and can therefore be produced in a very pure state.

By submitting a mixture of sesquioxide of uranium and carbon to the electric heat reduction is made in a few minutes and produces a metal having a brilliant fracture and an extreme hardness, and with a slight admixture of carbon presents the curious property of igniting on con-

1. From *La Nature*.

tact with silica. All these simple metallic bodies melt at the very highest temperatures; beside them we placed other metals, whose minerals are very rare, such as zirconium and vanadium.

During these long researches we have had occasion to handle currents of greatly varying strengths. Beginning with a small machine of 4 H. P. they have been gradually increased up to machines of 100 to 300 H. P., situated in the station of the Edison Co., an illustration of which is given in the accompanying engraving, which shows the furnace placed on a table. These studies have led us to the conclusion that the heating power of the electric arc certainly increases with the intensity of the current. M. Rosetti looked upon the electric arc as possessing a constant temperature, independent of the current, and he attributed to this arc the excessive temperature of 4,800 degrees, and at the positive electrode with the current furnished by 120 Bunsen elements a temperature of about 4,000 degrees, although physicists have not yet measured this in a reliable manner. With the enormous heat given out by the arc we are very certain that we are very far from the 2,000 degrees which we obtained formerly in the laboratory.

By means of a machine of 300 H. P. titanium has also been prepared in large quantities, the properties of which are entirely different from those formerly attributed to the gray powder bearing that name. This body takes fire in fluorine, it does not decompose water except at red heat, and possesses the curious property of burning in nitrogen at high temperature, furnishing the nitrate of titanium. It combines easily with carbon and silicon, but not with argon.

I am convinced that the working of metals by means of the heat of the electric arc will be developed to a very high degree. One will thus avoid adding to the mineral all the impurities of the coal, the gangues and the fluxes will disappear, and finally one will bring to the desired temperature the mixture to be put into reaction. As an example we may mention the production of carbide of calcium, which by contact with water disengages acetylene, for the production of which works are being erected in America, England and Germany.

ELECTRIC TRANSPORTATION DEPARTMENT.

THE BALDWIN-WESTINGHOUSE ALLIANCE.

The great industrial alliance of the Baldwin Locomotive Works and the Westinghouse Electric Manufacturing Company is already at work on designs for standard equipment. It is proposed to turn out a type of electric locomotive that will be an answer to the inquiries and demands that are being made all over the country. Whether the motor trucks that will be constructed for light and for heavy service will be put under the cars will depend entirely upon the conditions in which they are used. The essential thing is to get up designs for trucks to carry the motors, which will be up to the best locomotive practice in economy of construction, safety of operation, and ease and economy of repair. When this equipment has been designed, doubtless one, or two, or three motor trucks will be built, and will be used experimentally. The companies have many requests for plans and estimates for electrical equipment of existing lines and of projected lines, and it is highly likely that they will have all they can do as soon as their standard equipment is thoroughly worked out. It is not yet learned that the contracting parties have been asked for designs for equipment for main lines of railroad, and it is doubtful whether such a request would meet with much encouragement, at all events, for some little time to come. The question of the speed of the new form of locomotive is for the present a secondary consideration. Mr. D. L. Barnes, the consulting engineer of the combined companies is quoted as saying: "What the public wants is not a high speed, for that is merely spectacular. They desire quick transit, and this is provided by a high average of speed as distinguished from a high maximum of speed."

LIGHT RAILWAYS.

Some interesting reports from British representatives abroad on the subject of light railways have just been issued says the London *Electrician*. Their publication has been delayed owing to the despatches having been placed, in manuscript, at the disposal of the committee of the conference convened by the Board of Trade to consider the question of light railways and tramways. In Belgium there are 75 such lines extending over 836 miles. Of these, six belong to private companies and the remainder to the National Society of Local Railways. Dividends have been steadily increasing. Agricultural products have certainly been benefited by the establishment of light railways, the most remarkable instance being the culture of beetroot, which has received a great impetus, and has, in turn, given rise to the establishment of a large number of sugar factories. In Prussia the light railways, or "Kleinbahnen," number 87, with a total mileage of about 480 miles. Of these the German Government says: "In general the light railways appear to be well adapted to the development and improvement of agriculture and forestry and their accessories, particularly to opening up new markets and facilitating the carriage to and fro of manure and raw produce over a considerable area of country."

The operation of roads of this class by electricity will probably be the next step in the evolution of this class of transportation.

TROLLEY LINES TO THE ATLANTA EXPOSITION.

The Atlanta Consolidated Street Railway has perfected plans for its terminal at the Wilson avenue entrance to the Exposition grounds. The station will be circular and enclosed within a circular space, the track running around in the form of a loop from the entrance to the exit. This loop will be separated from the Exposition grounds by a fence at which turnstiles will be located. Going in on the right of the loop passengers will buy Exposition tickets and pass through the turnstiles. Coming out of the Exposition grounds visitors will buy street railroad tickets and enter doors arranged successively along the platform on the left of the loop. Each door represents a car route, and this will be indicated by signs overhead; all car lines will converge on the Exposition grounds, and passengers returning can take a car for any part of the city. Below the doors of the different car routes is an exit marked "overflow" and when cars for special routes are not full, they will stop at the overflow and take passengers for the centre of the city. A terminal station similar to this one will be at the Jackson street entrance and converging on the two points cars will come from every quarter of the city.

MORTGAGE OF THE CICERO & PROVISO ROAD, CHICAGO.

A mortgage for $2,500,000 has been filed by the Cicero & Proviso Street Railway Company. It was given to the Illinois Trust and Savings bank, and is for the purpose of securing bonds. The individual bonds have a face value of $1,000, and run for twenty years, with interest at 5 per cent. per annum. About one-third of the issue, or bonds to the amount of $871,000, will be used to take up the first mortgage bonds of the road, amounting at par to $740,000. The remaining $1,400,000 of bonds will be expended in improvements and extensions contemplated.

LONG DISTANCE WORK IN CLEVELAND.

A special dispatch of Aug. 6 from Massillon, O., says: Gov. McKinley a few years ago appointed a commission to study the subject of road improvement in Ohio. The committee took its own time, and finally filed its report, which ignored the subject of road improvement, taking the ground that the age of electricity was at hand, and recommended a network of tramways, which should usurp the functions of the plodding farm horses. The report was regarded as the work of dreamers at the time, but now a project has been launched, framed upon the lines suggested in that report. The Wadsworth Electric Railway Company has been chartered to build a road from Wooster to Cleveland. It is privileged to carry passengers, baggage, express goods, United States mails and freight; to build single or double track, with all necessary spurs, switches, etc. The significance of the spurs is in this: It is designed to be a road for the public, thrown out where cars can be left for farmers, dairymen, gardeners and others to load their products, which can be run to meet any market at any point along the line, thus enabling persons within five miles of the road on either side to avail themselves of any market. In a

circular the company say: "We expect to haul farm products, hay and straw in bales, grain, dairy products, coal, dry goods, boots and shoes, clothing, etc. So it will be of value to all classes of society and for all commercial interests. It is proposed to run express cars at twenty miles per hour, accommodation cars that will pick you up and let you off anywhere, and freight cars."

THE WASHINGTON METROPOLITAN UNDERGROUND SYSTEM.

The Metropolitan Street Railway Company of Washington, has, it is claimed, demonstrated conclusively that the underground electric system is better suited to the operation of street railways than the overhead trolley. The company has been experimenting with the new system recently illustrated in THE ELECTRICAL ENGINEER, for some time, and the tests have been so satisfactory that the management has decided to change the motive power of all the lines under its control from the overhead to the underground electric system.

In a letter to Third Vice-President Spence of the Mercantile Trust and Deposit Company, Baltimore, President Phillips said that the company was operating 16 motors and two trailers on the Ninth-street line, with the underground system, and that the earnings showed an increase of about 75 per cent. Formerly the F-street and Connecticut-avenue lines furnished two-thirds of the receipts to the Ninth-street line's one-third. Now the earnings of the latter are greater than the combined receipts of the two former lines.

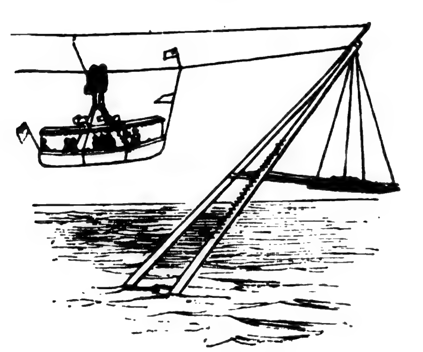
President Phillips also said that the cost of operation was less under the new than under the overhead trolley system. The work of changing the motive power on the F-street and Connecticut-avenue lines is being pushed with all possible haste.

THE DEMAND FOR HORSES.

Since I have been in the horse business, says Mr. I. H. Brockway, of Boston, Mass., there have been a great many inventions, such as electric cars and bicycles, which one would think would stop the sale of horses, but I find that my trade has increased more than 50 per cent. in the last three years, and there have been more horses sold in Boston in the last year than ever were sold in one year before. Why? Because the horse has been sold more cheaply, and more have been used for pleasure, both under the saddle and harness, and for heavy draught work. And, in my opinion, good horses will be worth twice as much in two years as they are now, because the farmers in the West, where they are raised, have got the idea that they would not be worth raising.

AN AERIAL TROLLEY BOAT.

THAT paradise of popular amusements, West Brighton, Coney Island, has this year added to its attractions an electrically propelled boat. But the novelty of the arrangement consists in the fact that the boat does not travel on the water but over it. The arrangement is shown in the accompanying engraving. As will be seen the boat is suspended from a cable, 825 feet in length, which extends out some distance into the water, being supported by shears at both ends. The shears at the seaward end of the line are inclined outwards at an angle and to help counteract the strain of the cable on them a weight of five tons, consisting of



THE AERIAL TROLLEY BOAT AT CONEY ISLAND.

bags of sand upon a platform, is suspended from their highest point. In the rear of the shore end of the line is a building containing the dynamo that supplies the necessary power, and from the cable hangs a 10-horse-power motor. Beneath the motor swings the boat in which the passengers sit.

In the regular trip of the trolley the boat is carried just high enough to clear the spray of the breakers, and a pause of a few minutes is made at the outer terminus to give the passengers a view of sea and shore from their unique position.

THE TONAWANDA WALKING ELECTRIC MAN.

ELECTRICITY has been called upon in innumerable ways by the enterprising advertiser to catch the eye of the public, and invariably with success. It has usually been employed for obtaining spectacular advertising effects, but the latest electrical device employs it as a motive power to drive a vehicle apparently propelled by a man. The accompanying engraving illustrates

THE TONAWANDA ELECTRIC MAN.

the show wagon built by Messrs. Gillie, Godard & Co., of Tonawanda, N. Y. The wagon is seemingly pulled along the street by the dummy in livery who raises his feet and imitates all the motions of a person walking. Inside the wagon is a motor driven by a storage battery. A sprocket and chain gears to the wheels, and a link movement attached to the dummy's hips imparts the walking motion to his legs. The "electric man" on his rounds has attracted much attention in Tonawanda.

TWO MORE STEAM LINES TO BE ELECTRIFIED.

The Whitefish Bay railroad, Wisconsin, will be changed from a steam or "dummy" line to an electric line early next year, by the Milwaukee Street Railway company.

The Lutheran steam line of the Brooklyn Heights Railroad company, running between Ridgewood and Lutheran cemetery, Brooklyn, has been changed to an electric line and hereafter cars will run more frequently, giving better service to the public.

ELECTRIC RAILWAY RETURNS IN ROCHESTER, N. Y.

The report of the Rochester Railway Company for the quarter, ending June 30th, has been filed. The report shows: Gross earnings from operation, $220,167.02; operating expenses, $127,096.98; net earnings from operation, $93,070.04; income from other sources, $1,536.66; gross income from all sources, $94,606.70.

The report for the same quarter of 1894 showed: Gross earnings from operation, $179,969.47; operating expenses, $104,042.69; net earnings from operation, $75,926.78; income from other sources, $1,949.98; gross income from all sources, $77,876.76.

SALE OF THE ST. JOSEPH, MO., TROLLEY AND LIGHTING PROPERTIES.

A SPECIAL dispatch of August 22 from St. Joseph, Mo., says:—The St. Joseph street railway lines, together with all the rolling stock, real estate, and other property used in their operation, and all the property of the St. Joseph Traction and Lighting Company, were sold at public auction yesterday and were bid in by E. A. Noyes, of Portland, Me., and Edward P. Harrigan, of New York, purchasing trustees of the stockholders of the company, for $800,000, which was the lowest bid that could be accepted under order of the court. The sale was made to satisfy a mortgage held by the Central Trust Company of New York.

MODEST TROLLEY FIGURES IN PHILADELPHIA.

Messrs. L. H. Taylor & Co. of Philadelphia issue a special circular on the street railway consolidation in that city. The Union Traction Company now owns and controls about 420 miles of street railway and is capitalized, including the constituent companies, for $41,410,600 funded debt and $87,891,000 stock, of which $21,000,000 is placed in trust. Fixed charges, less rentals received, are estimated at $5,889,400 a year. The calculation of dividend prospects place operating expenses at 50 per cent.

THE West End Street Railway Company has contracted with the American Electric Heating Company to equip 750 of its 889 cars with electric heaters, the work to be finished by Nov. 1.

LETTERS TO THE EDITOR.

LOSSES IN HYDRAULIC ELECTRIC RAILWAY GEAR.

On behalf of one of my clients I should like to ask what the Dey-Griswold Company do with the heat generated in their hydraulic gear described in your journal of August 7, on page 180 and commented on in your editorial column. All the lost mechanical energy (due to the torque of the motor multiplied by the difference in speed of the motor and the driven parts, at starting, or at slow speed) is necessarily converted into heat, and I am informed that practical experience has shown that apparently all of this energy is transformed into heat generated in the liquid, whether oil or water, as it is forced through the hydraulic gear. Indeed, it is hard to see how else to account for this lost power.

About three or four years ago there was an interference proceeding in the Patent Office on a gear substantially identical with that shown in the drawings in the ENGINEER, and if I remember correctly *fourteen* "original inventors" contended over the invention. The thing was thought to be of great value at the time, but for the excessive heat generated. If the Dey-Griswold Company will give the public the benefit of their experience in this matter, it will, I think, be of considerable interest to engineers, and especially so to me.

HAROLD BINNEY.

In reply to the above communication of Mr. Harold Binney I will say that Mr. Binney's client does not seem to understand the principle of the system he is criticizing. He has confounded it with the shunt liquid devices which have been patented by numerous inventors and experimented with by at least two large electrical concerns. I thought of the same device before inventing my present system and passed it by as impracticable. I appreciated the force of Mr. Binney's objections without spending money to obtain a hind-sight at it.

If Mr. Binney will look a little deeper into the principles of our system he will see that the torque varies inversely as the speed, so that the product of the two are always equal. The mechanical efficiency is slightly higher at slow speed, due to the slower speed of the fluid.

I would like to quote the following from a letter written by Prof. W. A. Anthony and published in THE ELECTRICAL ENGINEER, of Feb. 20, 1895:—

"It would be a great gain to electric transmission for railway work if some thoroughly efficient and reliable means could be devised for maintaining the high efficiency of the motor while running the train at varying speeds. This must be done either by changing the counter E. M. F. of the motor or by a gearing permitting of variation of the speed relations between motor and axle. It must not be done by introducing resistance to lower the speed of the motor or by any frictional device or shunted liquid gearing where energy is wasted in friction. Most of the devices proposed for varying the speed relations between motor and car axle have been open to this objection. One method proposed, I am not sure that it was ever tried even experimentally, is theoretically correct, but perhaps might not prove successful in practice. It consists in connecting the electric motor to the car axle by liquid gearing, there being several liquid motors on the car axle through one or more of which the liquid put in motion by a pump driven by the electric motor, could do its work. When all the liquid was forced through one motor a high speed would result, when it was divided between several motors the speed would be slow, but the efficiency of transmission would be as high for the slow speed as for the high."

The principle so favorably spoken of by Prof. Anthony is the same upon which we are working, with the exception that the variable capacity is in the pumps. I was working on the identical thing last winter and I think a friend of mine called Prof. Anthony's attention to it. The present method is a great improvement, as it does away with all steps and dispenses with the numerous valves, especially the reversing ones which were cumbersome.

I first thought of the variable pump idea in 1890 and constructed a complete working model, one-eighth size, having a pump with three compartments having capacities relative to each other as one, two and four. With this I could obtain seven different speeds by short circuiting various combinations, letting the balance do the work. This had the disadvantage of running idle pumps the greater portion of the time, which the present system does away with. Oil is an incompressible fluid and there is no excuse except poor designing or workmanship for having a hydraulic system heat.

I have made an exhaustive study of this subject during the past five years, and have consulted with the best hydraulic engineers, and the more I dig into the facts the more my faith increases. There was a time when it was not considered possible to run a dynamo without keeping a stream of water running through it. That same remark in the past tense will be applied to the liquid transmission of power before many years.

HARRY E. DEY.

NEW YORK, Aug. 17, 1895.

THE SUPERIORITY OF THE DIFFERENTIAL ARC LAMP.

REFERRING to the articles of Mr. E. R. Knowles on "The Shunt *vs.* the Differential Arc Lamp" in your issues of June 26 and July 3, I beg to call your attention to a pamphlet of mine entitled "On Arc Lamp Circuits," (Hans Paul, Leipsic, 1894), in which this subject is treated mathematically and in detail. I have also arrived at the result that the differential lamp is always to be preferred.

DR. LUXENBERG.

DRESDEN-TRACHAU, GERMANY, July 28, 1895.

SPEED OF ELECTRIC LOCOMOTIVES.

IN a recent article which appeared in THE ELECTRICAL ENGINEER, Mr. Robert S. Ball agrees with Mr. H. G. Prout in saying "that an electric locomotive has not yet been made that could outrun the steam locomotive"; but he contends that if "they are to build engines of either type to pull trains at a higher speed than at present, the electric locomotive will be selected for that duty."

I beg to call the attention of both gentlemen to Mr. Oscar T. Crosby's article in THE ELECTRICAL ENGINEER of July 17, on "The Problems of Electric Railway Work," in which he claims the electric locomotive offers an advantage over the steam locomotive at very high speed. The maximum recorded speed of a steam locomotive with train is 112 miles per hour, while that of an electric motor is 120 miles an hour made under Mr. Crosby's personal supervision. I trust the gentlemen in question will read Mr. Crosby's article.

D. E. WHITING.

CHICAGO, ILL., Aug. 16, 1895.

IN justice to the gentlemen referred to by our correspondent, and not less to Mr. Crosby himself, it is well to point out that the article which appeared in our issue of July 17, as there stated in a foot note, was an interesting interview had with Mr. Crosby by the untechnical reporter of a daily newspaper. Hence certain allowances must be made on technical points. The electric locomotive which Mr. Crosby refers to as having attained a speed of 120 miles an hour was entirely experimental in its nature, carried no passengers or motorman, and indeed consisted practically of little more than a narrow gauge truck, upon which the motors were mounted and enclosed in a cigar-shaped housing. Mr. Crosby was careful to say that the speed was "made experimentally," but it would seem that the reporter's phraseology referred to may have been slightly misleading.—EDS. E. E.

VIOLATIONS OF FIRE UNDERWRITERS' RULES IN NEW YORK.

As consulting engineer I desire to enter a most emphatic protest against the outrageous manner in which the electric light equipment is being placed in position in the new buildings to be occupied, when finished, by the St. Luke's Hospital. The work as far as completed is absolutely in violation of the rules and regulations of the New York Board of Fire Underwriters, and not only that, but the manner in which the work is placed in position is such that the electric light interests of this city will be greatly injured owing to the fact that there will undoubtedly be constantly more or less trouble with the equipment, and naturally the electric lighting interests will be criticised, and the blame not placed upon the proper parties.

For the information of your readers, who are not acquainted with the facts, the undersigned would state that the wiring as originally commenced was single brass armored conduit work, it being designed to use twin wire within the conduits. This work was immediately condemned by the undersigned, acting for the Bureau of Electrical Inspection, and it was also condemned by Inspector Forsythe of the New York Board of Fire Underwriters, but for some unaccountable reason the New York Board, through its representatives in the Survey Department, went over the inspector's head and passed the work and allowed the contractors to proceed.

Not satisfied with placing single brass armored conduit in position, the contractor has lately resorted to Circular Loom tube, and is drawing in twin wires. The manner in which the Circular Loom tube is placed in position is such that an inspection made recently showed that the tube has been placed under radiator coils, buried in cement, placed outside of cement, alongside steam pipes, across steam pipes, over iron girders, around the edges of iron girders, run crosswise over cement floors, and said tube (by digging up portions of it) was found flattened or crushed by being struck with mechanics' tools, and thereby rendered practically useless as a conduit,—to say nothing of the fact that it is but a question of time when the insulation upon the twin wires is liable to give way; and although no fire may be caused to the building, there will be an interruption of the electric light service, which can only be repaired by running wires upon the outside, as anyone who has seen the manner and methods employed in this particular installation knows that it is a physical impossibility to

withdraw the twin wires from the single Circular Loom tube, as placed in position.

In two cases it was also noted that Circular Loom tube has been pieced out with brass armored tube. In the first place it should be noted that such work would never have been contemplated nor placed in position if it had not been for the peculiar action on the part of the New York Board. Why they acted as they did is beyond comprehension. The indisputable facts are, however:

1. The installation has been placed in position in violation of the standard rules of the Underwriters, and by their consent.

2. It has been placed contrary to the usual practices that are employed in high grade work, such as the authorities in charge of the erection of this building certainly expected to get.

The equipment is in, or more than three-fourths of it, and what are the authorities going to do about it? The writer hopes that this communication may be the means of calling for an investigation of the statements made above, and the blame placed where it belongs. In a building of this character there should not have been the slighest hesitancy as to the best methods to be employed, and *iron armored conduit*, which is, up to the present time, the best form of construction work that can be recommended, should have been placed in position.

FREMONT WILSON.

NEW YORK, Aug. 23, 1895.

LITERATURE.

Special Agents' Electrical Hand Book. By A. M. Schoen, New York; 1895. The Spectator Co. 113 pp. 4 x 6 inches. Flexible covers. Price, $1.

This little work is intended more particularly for the guidance of insurance inspectors, showing them where to look for defective work, and pointing out methods to be employed in electric wiring work, and the general erection of electrical machinery in isolated plants. It ought to prove a handy little pocket companion for the insurance inspector.

Practical Directions for Electric Gas Lighting and Bell Fitting for Amateurs. (Third Edition.) By E. Trevert. Lynn, 1895. Bubier Publishing Co. 62 pp., 4½ x 7 inches. Paper. Price, 25 cents.

Cours Elémentaire d'Electricité By B. Brunhes. Paris, 1895. Gauthier-Villars & Fils, 265 pp., 5½ x 8½ inches. Paper. Price, $1.40.

Electricity in our Homes and Workshops. By Sidney F. Walker. (Third Edition, revised.) New York, 1895. D. Van Nostrand. 346 pp., 5 x 7 inches. Cloth. Price, $3.

IN the present edition the author has largely added to his chapter on telephones, describing the latest forms of apparatus. A short chapter has also been added on dry batteries.

National Electric Light Association. Report of the 18th Convention held at Cleveland. New York, 1895. The James Kempster Printing Co. 269 pp., 6 x 9 inches. Cloth.

ALTHOUGH not quite so bulky in volume as some of its predecessors, this report contains much that is of permanent value both in the papers and in the discussions to which they lead. The frontispiece is a good portrait of past president M. J. Francisco.

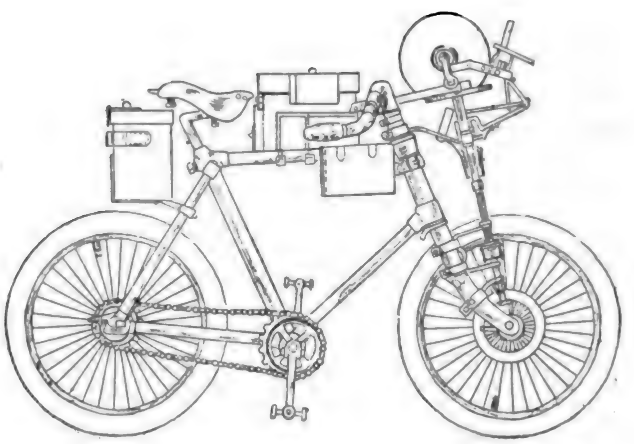
COMMENTS ON THE DATA SHEETS.

Mr. Paul Lupke, the electrician of the Trenton, N. J., Electric Light & Power Co. favors us with the subjoined interesting comment on THE ELECTRICAL ENGINEER Data Sheets:—"I am taking great interest in the Data Sheets and I am patiently waiting for more. May I offer a suggestion? Would it not be well to print the data of issue on each Sheet instead of over the top of them? You know very well that electrical data do not improve with age, and that in most cases it is of great value to know the time at which the data were considered correct. To the Sheets you have issued so far I have added a number of blanks, properly numbered according to your index and filled up with data from current literature. I am inclined to think that many of your readers would feel obliged to you for the issue of some blank sheets. This would afford an easy and comfortable way to lay hold of stray bits of information, which we run across now and then, and do not know just where to put to have them handy when needed. No doubt many of these temporary sheets would in time be replaced by your regular ones, but in the mean time they will certainly serve a good purpose. Enclosed find 60 cents for which you will please send me one of the filing cases."

NEW SIGNAL SERVICE BICYCLE.

The U. S. army signal officers have equipped the service with an ingenious arrangement for distributing telegraph and telephone wires. It was found that in laying insulated or naked wire on the ground preparatory to establishing communicating stations, the weight of the reel containing the wire was considerable, and it had to be carried on a handcart. This arrangement required two men in the operation—one to push the cart, the other to wind and unwind the wire. The latest method is to carry the wire on a reel which is fixed to a bicycle. The rider, by his propulsion of the wheel, distributes the wire in the track of the machine. An ingenious mechanism also permits him to rapidly gather up the wire from the ground, and it is reeled on a spool borne in front of the handle bar.

This use of the bicycle is a great saving of labor and time, and will be of great value on the battlefield, when the rapid construction of communicating lines is of great importance. In front of the saddle this Signal Corps bicycle will support a case of instruments and tools, in addition to the usual leather pocket in which the bicycle implements are carried. Supported over the rear wheel of the machine, and directly behind the saddle, is the case which contains the telegraphic and telephonic instruments. This can be removed, and a communicating station established anywhere along the line.



A SIGNAL CORPS BICYCLE.

This bicycle has been tried with much success in Texas, and it will be adopted generally by the signal linesmen. The bicycle will probably relieve the corps of much travel, and its lightness, even with the reel of wire and instrument cases, readily permits its being lifted over obstructions, such as stone walls, hedges, and fallen trees. It will enable the operators to work with speed, both in laying and in gathering the lines of wire. The reel will carry insulated as well as naked wire, experiments with the latter having proved that it is also of much value.

GROWTH OF THE NORTH AMERICAN TELEGRAPH CO.'S SYSTEM.

THE North American Telegraph Company has taken complete charge of the commercial business done over the telegraph wires of the Soo line. Though closely related heretofore, the two companies have maintained separate offices in Minneapolis, the Soo telegraph business being attended to at the office of the company in the Guaranty Loan building, that city. Speaking of the new arrangement, H. A. Tuttle, general manager of the North American, says: "This is a decided advance for our company and puts us in better shape in several ways. We now have direct control of all the commercial business on the Soo lines for a distance of 1,200 miles altogether. There are, of course, no large places on these lines, but there is a considerable amount of business originating along the system. We also get the benefit of a direct line into Winnipeg by virtue of an arrangement with the Canadian Pacific from the international boundary. The lines of the North American proper include about 600 miles from Chicago through Minneapolis to Duluth. By connection with the Postal Telegraph Company at Chicago we reach every part of the world."

Mr. Tuttle intimated that this move of the company was the beginning of a policy of extension of its lines and interests through the Northwest. There are many good towns that would welcome a new company, and which it will be policy for the North American to reach.

C. M. Loring, president of the company, said that the move was better for the Soo line than for the North American, and that the recent extension of the Postal Telegraph lines to the Pacific was the most important advantage which had accrued to the company of late.

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CONTENTS.

SUPPLEMENT.

IS TELEPHONY TRIUMPHANT?

WE have the pleasure of presenting to our readers in this issue the full text of what must forever be regarded as one of the most important of the fundamental documents relating to and governing the development of both telegraphy and telephony in the United States, namely, the famous agreement of 1879 whereby the Western Union Telegraph Company, then an active competitor for the business, retired from the telephonic field, while in consideration of being left in full possession of the new domain the American Bell Telephone Company agreed to pay the handsome commission of 20 per cent. on its rentals or royalties. The document is full of interest at this juncture, when, as we show elsewhere, the telephone is everywhere parelleling the longer telegraph lines that yield the bulk of telegraphic income, and when it would appear that new adjustments to changed conditions must necessarily be in order.

Some of the daily papers have, we regret to note, presented seriously erroneous statements in regard to this famous document, and we are glad therefore to do the public service of setting matters right. It was hardly to be expected that either party to the agreement would go out of its way to correct the misstatements made; but as the document is, so far as we can form an opinion, creditable to the pacific intentions of both of them and exhibits the remarkable foresight of those who concluded it was better to enjoy a large income than to squander it on litigation, we think we may hold it up as an example that often might be followed most advantageously in electrical and other work. The ruination of many branches of electrical industry has been the frantic legal fighting in them and the destructive lowering of prices; but here we have clear evidence of a better way of doing things. It is obvious, also, that as an alternative to fighting or to consolidation, an agreement of this nature has many recommendations. The Western Union found it so in this case. We see, for ourselves, no ground for regret on its part, any more than we see any for regret as to its agreement with the Postal Telegraph-Cable Company to maintain rates at a living figure. The telegraph interests are subject like all others to the effect of new habits among the people, and must rise or decline in the long run as circumstances and events modify the environment; but skillful diplomacy will remedy many evil situations and not only find compensation for loss but new channels of unsuspected profit.

An agreement is essentially something to differ about, and hence it is not surprising that this famous document should itself have needed elucidation and interpretation. Some years ago, the Western Union Co. was understood to be seeking payment from the American Bell of moneys not nominated in the bond as rentals but which might bear that character. The final upshot of that contention has not been made known, so far as we are aware; the case even now, in some shape, may be slumbering quietly and conveniently on some court docket. Another point is the consent of the American Bell Company not to allow news matter to go over the telephone wires. For a long time past this has not been lived up to, but disregarded in a way of which the Western Union must be well aware.

For example there lies on our desk at this moment a late telephonic dispatch from New York in one of the Philadelphia daily papers, of no less than 55 lines, with a bold heading announcing the means of its transmission. One constantly sees such dispatches in the daily papers.

The date of expiration of this important contract is a matter of no little interest. According to Article 17, the contract would nominally expire seventeen years from the first day of November, 1879, but its continuance and further operation might well depend upon the Berliner patent, which has now become a football in the courts, but which as a means of sustaining monopoly fits neatly into the space left vacant by the expiration of the Bell fundamental patent named specifically in Article 2, section 8.

Triumphant Telephony is an idea that has seized upon many minds, but we can in no wise bring ourselves to believe that the telegraph is a defeated art or that when worsted it is to disappear off the face of the earth. It may be more sharply limited than it once was, but its future, to our eyes, is bright for usefulness, great and growing as the scope of telephony has now proved to be. The contrast between the relations in 1879 and those in 1895, as presented by our issue this week, is one of the most striking that electrical applications have ever shown. To-day our population averages barely over one telegram per head a year, while telephonic messages are more than ten times as numerous, the figures being in round numbers, respectively 75,000,000 and 750,000,000. Every twenty four hours the telephone is now used more than two million times, so that, broadly, four million people, or about 25 per cent. of the adult population, use it daily. Yet there was little prospect of such growth or of the infinite development now beginning under freer conditions, when the Western Union closed up or turned over its numerous telephone exchanges, and settled down to its own branch of the intercommunication industry.

IS THE PRESENT TYPE OF CENTRAL STATION DOOMED?

Dr. d'Arsonval, who easily ranks first among electrophysiologists of France and who is recognized as an authority the world over, has just concluded a series of experiments on the electrical activity of the torpedo, technically known as the *raia electrica*, which are of such transcendent interest that we have devoted a page to recording them. Dr. d'Arsonval's researches have shown conclusively that the current effects obtainable from the torpedo are far beyond what had ever been thought possible, and as a result they have a bearing on the work of the electrical engineer which must command immediate attention.

If, as Dr. d'Arsonval has shown, an able-bodied electric torpedo can be depended on to give 7 amperes at 17 volts its utilization for central station and isolated plant work must suggest itself at once. Thus, taking for example, a 5,000 lamp station, all that would be required would be about 2,500 amiable fishes, grouped seven in series to give 119 volts, and 357 in parallel. With a reliable and automatic method of pinching the fishes there ought to be no difficulty experienced in regulation; and lamp breakage from this cause ought to be insignificant. The small cost of installing a fish tank and the low rate of maintenance and fish food, as compared with the complication of boilers, engines, dynamos, coal expense and attendance, now required to generate current, leaves no question as to the superiority of the fish central station. Then again, with each fish capable of giving out 119 watts it would require only a fraction over 10 fishes to maintain twenty 50 watt lamps, a number sufficient to light the large majority of private houses. If the objection be raised that the fishes get tired after a while, it is a simple matter to have two or three sets installed and switch them on to the circuit successively, by means of the Pennock volt-distributor. Indeed, the more we examine into this subject the more we are convinced that in the direction of animal electricity lies the most promising opening for the future of lighting and that the electrical profession is under heavy obligations to Dr. d'Arsonval for pointing out the way of progress. As we go to press, the news reaches us that torpedo roe has gone up several hundred per cent. in price in consequence of a corner in the market.

CONDUIT ELECTRIC RAILWAYS.

There are not many conduit railways in this country, but the mileage that is actually in operation appears to be doing pretty well. The reports from Washington now are that, encouraged by its first success, the Metropolitan Company will untrolley some of its lines and put in more conduit. If true, this is decidedly important. In New York City, the conduit road uptown of the Metropolitan Traction Co. is doing remarkably well, and several of the cars are now hauling trailers. One disagreeable feature of the system appears to be the frightful dust accompanying the passage of the car. The swift movement of the car above the slot, and, perhaps, the construction of the conduit, sets up a small cyclone, and the clouds of dust at some points, each time a car goes by, are startling in their volume and density. We have never seen a trolley car or a cable car make itself quite so obnoxious in this respect; but the evil is assuredly possible of correction.

INDIRECT ELECTROLYSIS.

M. Andreoli has described in *Le Génie Civil* an experiment on direct electrolysis. Taking a cell divided into three compartments by porous diaphragms, a solution of any salt is placed in the central compartment, whilst the two electrodes are placed in the side compartments immersed in similar or different electrolytes. The decomposition of these latter is, on the current being passed, effected as if the central compartment did not exist, the solution in it being unaffected. In this form the experiment is an old one, but M. Andreoli finds that if a plate or series of plates is placed in the solution in the central compartment, reactions occur which can only be attributed to an indirect or secondary electrolysis. If, for example, the two outer compartments are filled with a solution of common salt, and the central one with a solution of cyanide of gold; let the anode in the one compartment be of carbon, and the cathode in the other of iron. On passing a current under these conditions chlorine is evolved at the carbon electrode, and caustic soda produced at the other, the cyanide solution being, as aforesaid, unaffected. If, however, whilst the current is passing, a series of metal plates are immersed in the cyanide solution, the gold is deposited on them, though neither chlorine nor soda appears to pass into the central compartment.

TELEPHONY.

THE AMERICAN BELL AND WESTERN UNION AGREEMENT OF 1879.

FIRST AND FULL PUBLICATION OF THE EXACT TEXT OF THE FAMOUS COMPACT OF 1879.

SUBJOINED is given the full text of the famous agreement of 1879, between the American Bell Telephone Co. and the Western Union Telegraph Company, by which the former agreed to pay the latter a commission of 20 per cent. royalty on its telephone rentals and the latter agreed to abandon its existing exchanges and abstain from all telephone business. This agreement nominally terminates, as will be seen, in November, 1896. It should be studied in connection with the article in this issue of THE ELECTRICAL ENGINEER on the remarkable development of the long-distance telephone system as a formidable competitor for business hitherto going over the telegraph wires.

THIS AGREEMENT, MADE THIS TENTH DAY OF NOVEMBER, 1879, BY AND BETWEEN THE *Western Union Telegraph Company*, FOR ITSELF AND FOR THE *Gold and Stock Telegraph Company*, *American Speaking Telephone Company*, AND *Harmonic Telegraph Company* WHICH IT REPRESENTS, PARTY OF THE FIRST PART, AND THE *National Bell Telephone Company*, PARTY OF THE SECOND PART, WITNESSETH:

ARTICLE 1. (1.) The party of the second part shall pay to the party of the first part, upon all telephones used in the United States, under any license from the party of the second part, express or implied, unless expressly excepted, a royalty or bonus of twenty per cent. of all rentals or royalties actually received or rated as paid in accordance with the provisions of this contract, from licenses or leases for speaking telephones (exclusive of call bells, batteries, wires, and other appliances, or services furnished or performed). The rentals or royalties upon which said royalty or bonus to be paid to the party of the first part is to be reckoned, shall, for that purpose, be ascertained by deducting from the gross rental or royalty received or rated as hereinafter declared, the commissions and allowances herein provided for.

(2.) The royalty or bonus to be paid on telephones made in the United States solely for export and not licensed for use in the United States, shall be twenty per cent. of the net profit actually derived by the party of the second part in their manufacture and sale above the cost of such manufacture, not including any part of the general expense of the party of the second part as part of such cost, and not including in the manufacturer's profit any enhancement of price fairly due to the fact that the party of the second part holds or in any way controls a monopoly of the use of such telephones in any foreign country other than Canada, if such case shall exist.

Provided, however, that where the party of the second part shall be in any way interested in the purchase or use of such telephones in such foreign country, it shall be at the option of the party of the first part to require an accounting for all telephones so exported as if sold at a fixed profit of thirty-three and one-third per cent. upon the cost of manufacture.

(3.) Allowance shall be made for rentals or royalties which cannot be collected, and for usual and reasonable deadhead or free privileges.

ARTICLE 2. Concerning the sum which is to be taken as the gross rental or royalty for the purposes of the preceding article, it is declared and agreed:—

(1.) The word "telephone," as used in this contract, refers to an instrument for electrically transmitting or receiving articulate speech, and is understood to mean either a transmitting instrument incapable of use as a receiver, a receiving instrument incapable of use as a transmitter, or an instrument capable of being used both as a transmitter and receiver.

(2). Ten dollars per annum for each telephone where only one is used at a terminal or station, and fifteen dollars per annum for a pair of telephones composed of an instrument used for sending and another instrument used for receiving, used at one terminal or station, are recognized as the present standard rates of gross rentals or royalties; and the party of the second part may change them, subject to the qualifications of section (4) and (5) of this article, but not otherwise.

(3.) Telephones used on exchanges or lines owned in whole or part by the party of the second part, or by auxiliary corporations or organizations in which it is interested, or rented together with lines owned in whole or part by it or by auxiliary corporations or organizations in which it is interested, shall be rated as paying to said second party the said recognized standard rates, or such other rates as may hereafter be established in accordance with this contract for like uses by parties other than the second party or auxiliary corporations or organizations in which it is interested, less the commissions and allowances provided for by this contract; but whenever the party of the second part is or shall be interested with others in the ownership of such exchanges or lines, the annual rental or royalty actually charged to and received from the owners thereof for the use of the telephones, if greater than the rates established as aforesaid, shall be taken to be the gross rental for the purpose of ascertaining the stipulated bonus or royalty.

(4.) No reduction from the present recognized standard rates which shall be made on telephones used on exchanges or lines owned in whole or in part by the party of the second part or by auxiliary corporations or organizations in which it is interested, or rented together with lines owned in whole or in part by it, or by auxiliary corporations or organizations in which it is interested, shall operate to reduce said royalty or bonus to be paid to the party of the first part below $1.00 per annum for each terminal single telephone, and $1.80 per annum for each terminal pair, unless such reduction be made with the consent of the first party, or as provided in the following section.

(5.) Whereas it is difficult to determine absolutely and in advance the price which at all times and for all purposes it will be advantageous for the interests of the patents and of both the parties as interested in income derived from royalties and rentals, to charge, either with a view of increasing the revenue of the parties hereto from royalties and rentals by enlarging the demand for the instruments, or under circumstances of competition, it is agreed that the party of the second part, in cases where its power to reduce is qualified as hereinbefore expressed, may reduce the rentals either generally or for a particular purpose, or a particular locality, or a particular licensee or class of licensees, to such sum as may be advantageous as aforesaid for the interests of both parties and as may be determined by agreement of the parties hereto, or as provided in this article. If the parties do not agree as to the propriety of such a reduction, or as to the amount, extent or manner thereof, then said second party may in writing notify the first party of its desire for a reduction, and shall specify in such notice the reduction it desires and the character thereof, and the reasons therefor, and request the other party to join with it in selecting and appointing three referees. If the parties hereto shall not jointly appoint three referees within seven days from the receipt of such notice, then the moving party may, within seven days after the expiration of said first period, name one referee and notify such appointment to the other party, and request it to appoint another referee within seven days after receipt of notice of such appointment. If said other party shall not appoint a second referee within said period, then the moving party may give to the party in default written notice of the former application and notices, and that the time therein specified has expired, and that the moving party has not received information of the appointment of a referee by the other in accordance therewith, and inclosing copies of said former notices, and the party of the first part within one week after receipt of the last described communication, may in writing appoint a referee and notify such appointment to the other party, and thereupon the reference shall be proceeded with as herein provided; and the change specified in the notice first given as above shall be deemed agreed to, and shall *ipso facto* take effect and be established upon the expiration of the period last above referred to, unless the other party shall appoint a referee as aforesaid within said period. Said two referees shall jointly select and in writing appoint a third within ten days after the appointment of the second of said two. If said two do not select and appoint a third within the period above specified, then the moving party may apply to any Judge of the United States Circuit or District Court in the cities of Boston, or New York, or Brooklyn, and request him to appoint said board of three referees. Said judge shall not be required to and shall not consider whether any occasion or right to such reduction exists, and he shall act summarily in appointing said three referees, having first given the parties reasonable opportunity to be heard on such notice as he shall think fit. If any judge applied to shall decline to act, then the moving party may apply to some other of the persons above designated. All the three referees, however appointed, shall be disinterested, and not officers nor in the employ of any of the parties named in this contract. An award in writing, made and signed by any two of them shall stand as the award of the board. Unless the decision is made and notified to the parties within thirty days from the appointment of the three referees, the moving party may, at its option, treat the reference as void and inoperative, and a new appointment may be called for in the manner and with the effect herein specified. Said referee shall have power to determine whether occasion for a reduction exists for the reasons stated in the preamble of this section, and if so, then to determine how far, to what extent, and for how long the said limitation on the power of the second party to reduce the rentals shall be removed or modified. After such removal or modification the said limitation, as modified, unless and until further changed as herein provided, shall stand and be in all respects in lieu of that hereinbefore declared. During six months after a decision so made, no new reference upon the same subject before submitted can be asked for; but during that period either party may apply to the same board of referees, and said board, if it shall find that a new state of facts, or new exigencies

have arisen and require some change, may make such change in their award as they find occasion for as aforesaid, and such change shall stand and be operative from the time it is made and notified to the parties until further change be made by said board within said period, or by a new reference called for after said period, or by agreement of said parties. If during said period any arbitrator dies, refuses, or for any reason is unable to act, then the vacancy shall be filled by said parties jointly, if they agree, and failing to agree, then by the two remaining referees, and if they do not so appoint within ten days after a request in writing from either party so to do, then the vacancy may be filled by some judge, as hereinbefore provided.

Twenty per cent. of the expenses and compensation of the referees shall be paid by the party of the first part and eighty per cent. by the party of the second part unless the referees shall otherwise order. The notices herein required to be given may be given to the President or Secretary of the Western Union Telegraph Company or persons acting as such, and to the President, Secretary or Treasurer of the National Bell Telephone Company or of its successors, or persons acting as such officers.

It is however expressly agreed and further provided that the party of the first part, at any time after the receipt of actual notice of an actual reduction of rates in consequence of its default, as aforesaid, may in the manner above provided, on alleging and showing to the party of the second part, and upon their failure to join in a reference, as aforesaid, then upon showing to any of the judges above referred to that it did not receive and was not informed of the notices to appoint and the communication of such notice, above described, require and obtain, in the manner above provided, the appointment of a reference to consider any reduction thus fixed by default, and the referees thus appointed may, by award, in whole or in part, restore the former limitation on the power to reduce rates, which restoration shall take effect from the date of said award.

If, from any cause, a reference twice called for shall fail to produce a valid determination as herein contemplated upon the matter submitted or to be submitted, then the party aggrieved may have such relief or protection in a court of law or equity in the premises by a specific performance or otherwise, as such court can afford.

(6.) Telephones for speaking-tube purposes, that is, instruments to be used for speaking from one part of the licensee's premises or from one of his buildings to another analogous to the use of speaking tubes, or telephones to be used by institutions of learning for scientific purposes, or telephones for connecting persons and families for social or household purposes only, not connecting with any exchange or central office; and telephones which are not to be used in circuit with any exchange or central office, and are not rented together with lines owned by the party of the second part directly or indirectly or by any auxiliary organizations in which it is interested, may be put out either at lower rentals than the standard, or at a gross sum to be paid in one payment, according to the discretion of the party of the second part; and in respect of such telephones the royalty or bonus is to be twenty per cent. of the reduced rental or gross sum, less commissions actually paid as herein provided.

(7.) The party of the second part may increase the established annual rate either generally or upon telephones used for any particular purpose, or by any particular class of licenses, from time to time at its discretion, and such higher rates, while in force, shall be taken to be the gross rentals or royalties in respect of the telephones for which they are obtained.

(8.) The limitations on reductions herein contained shall not apply after the expiration of the patent of the United States No. 186,787, granted to Alexander Graham Bell, January 30, 1877, which patent will expire January 30, 1894, unless some other patents owned by the said party of the second part, or under which it has exclusive licenses, shall operate to control the use of all speaking telephones substantially as they are now controlled by the patents represented by the two parties hereto.

ARTICLE 3. (1.) In ascertaining rentals on which the royalty or bonus is to be paid to the party of the first part, there shall be deducted from the gross rentals the following commissions and allowances:

On telephones used in district or exchange systems owned in whole or in part by the second party, or by auxiliary corporations or organizations in which it is interested, an allowance or commission of thirty per cent.

On telephones taken by the first party for private lines as hereinafter provided, or used by the second party on its own lines or put out by it, by its own officers or servants for any use other than on district or exchange systems in which it is interested as aforesaid, twenty-five per cent.; and the party of the first part or those it represents, shall be allowed said abatement of twenty-five per cent. from the standard rentals upon telephones leased to it or them, except where contracts heretofore entered into by said party of the second part oblige it to pay such rate, or a higher rate of commissions to its present licensees.

Upon all telephones other than the foregoing, such rate of commission as shall actually be paid, not to exceed forty per cent., except so far as existing contracts may call for higher rates.

ARTICLE 4. (1.) The party of the first part shall bear and pay twenty per cent., and the party of the second part eighty per cent. of all reasonable legal expenses incurred in ascertaining, investigating and determining, and in prosecuting and defending rights which the party of the second part may have, claim, or wish to acquire, pertaining to telephones or the right to use telephones, or to inventions used in telephones, and concerning patent rights which it or others may claim respecting the same, including expenses in suits and in proceedings in the Patent Office relating to such rights or to the collection of rentals or royalties on telephones. Expenses, incurred in whole or in part in respect to inventions or improvements which are or may be used otherwise than in telephones, shall be apportioned, and such part thereof as may be justly chargeable to the telephone interest shall be borne by the parties hereto in the proportion above stated, and such part thereof as shall justly be chargeable to other interests shall be borne by the owners thereof.

(2.) The party of the second part may, from time to time, acquire such inventions and improvements in telephones as it shall deem advisable, and may introduce such of them as it sees fit into the construction of telephones put out to its licensees, and to reimburse itself for the cost thereof, may charge an additional price to its customers beyond the price then previously charged, but such an increase shall not operate to increase the royalty or bonus payable to the party of the first part hereunder until said second party shall have been so reimbursed, unless said first party shall elect and assent to bear and pay twenty per cent. of such cost. Or if the party of the second part shall deem it advisable not to raise the price as aforesaid, then the party of the first part shall bear, pay and be charged with twenty per cent. of said cost actually and in good faith incurred and paid, and the party of the second part shall bear, pay and be charged with eighty per cent. thereof. *Provided*, that if such payments are for rights which extend beyond the duration of this contract, or which are to be applied to purposes other than telephonic, then only a *pro rata* proportion, according to time or the purpose for which they are used, shall be borne by said first party. *And provided further*, that if the purchase of any one patent calls for an absolute payment exceeding $10,000, no portion of the excess over that sum shall be charged to the party of the first part, unless it shall consent (and full opportunity shall be afforded it to do so) or it be determined by the board contemplated in Article 2, or by some other competent tribunal, that it should be so charged in respect of such excess; and said board shall so determine if, or so far as they shall find that said purchase was prudently made for the benefit of the parties hereto. Said second party shall call for said reference, and the referees shall be appointed, and such proceedings shall be had in reference thereto as are provided in said Article 2, so far as they can apply; and the questions submitted by the notice calling for said reference shall be determined by the default of the party or the decision of the referees, as therein provided; and the determination so arrived at shall be final and conclusive upon the questions so submitted.

ARTICLE 5. (1.) The party of the first part, for itself and those it represents, as aforesaid, hereby grants to the party of the second part, as far as they or either of them have the legal power so to do, an exclusive license during the full terms for which patents thereon have been or may be granted, to make, to use, and to license others to make and to use in speaking telephones, call bells, and switches, and other appliances for use on telephonic lines, any inventions or improvements therein which it, or those whom it represents, as aforesaid, now own or control, in whole or in part, by contract or otherwise, under which it or they have the authority to grant such license, and whether already patented or not, and which the party of the second part shall not otherwise have the right to use; reserving however to the party of the first part, and those it represents, the right to use said inventions in switches, call bells, and appliances other than telephones in connection with the telephones which they are or may become entitled to use under this contract. Instruments or apparatus made under this license shall be deemed to be licensed only for the uses above named, and not for any other purpose.

(2) And the first party further agrees to acquire any further inventions adapted to be used in connection with telephones which it may have the right to so acquire under existing contracts with George M. Phelps and Thomas A. Edison, and to license the second party under the same for use in telephones or on telephone lines, the second party agreeing to pay to said first party in reimbursements, whatever the said first party or those it represents may be required to pay therefor under the ninth, tenth, eleventh and thirteenth clauses of the agreement between Thomas A. Edison and the Western Union Telegraph Company, dated May 31, 1878, and whatever it may be required to pay said Edison under the contract between the same parties, dated May 12, 1879, and whatever it may be required to pay George M. Phelps in addition to his salary of $3,300 therein referred to, to acquire his inventions under the contract between him and the Western

Union Telegraph Company, dated January 20, 1876, or a due and proportionate part thereof, in case said inventions shall also be applicable to uses and purposes other than telephonic, said licenses to be exclusive during the term of this contract, and to continue but not to be exclusive thereafter; the character and extent of such license shall be taken into account in arriving at a fair proportion of the actual cost thereof.

(3.) And if the parties of the first part shall hereafter acquire ownership or control as aforesaid of other inventions adapted to be used in connection with telephones, the second party shall have the right or license to use the same for telephonic purposes, and shall be bound to pay to the party of the first part the cost thereof, or a due and proportionate part of said cost. Such right or license shall be exclusive for telephonic purposes during the whole period of this contract, and shall continue, but shall not be exclusive after its expiration; the character and extent of such license shall be taken into account in arriving at a fair proportion of the actual cost thereof.

(4.) Said second party will pay on instruments, which shall be made by or for it, the royalties specified in Schedule A, hereby referred to and made part of this agreement, so far as the first party or those it represents shall be bound to pay the same under the contracts therein referred to, unless it may have the right to make and use such instruments irrespective of this contract and of the contracts referred to in said Schedule by reason of the invalidity of the patents therein referred to, or otherwise, in which cases it shall not be deemed to be acting under any license from the party of the first part or those it represents; but it hereby agrees to indemnify the party of the first part and those it represents for any such royalties it or they may be legally bound to pay by reason of any use by the party of the second part.

(5.) This contract shall operate as a release to the parties hereto, and those they represent, and their respective licensees and predecessors, for all claims for infringement of patents on which suits are now pending, in which said parties, or any of their licensees or predecessors are parties, and all claims for infringement of other patents or inventions owned or controlled by them, or either of them, growing out of, or based upon, the manufacture or use of telephones now used in territory to which this contract applies at once; but, as to telephones in territory to which it does not apply at once, it is not to operate as such release (and each party stands on its own right in such conflicting territory) until settlements are made and interests harmonized as hereinafter provided, or until the parties hereto agree that it shall operate as a release upon telephones in such localities, and in either of such cases it shall thereupon operate as a release in respect of telephones in such locality.

ARTICLE 6. Except as herein provided, the first party and the companies it represents agree to withdraw from the manufacture, rental and use of telephones.

ARTICLE 7. The party of the first part agrees to give assistance and co-operation in developing and extending the use of the telephones of the party of the second part; and that the party of the second part shall, during the term of this contract, and when in the judgment of the first party it shall not interfere with the enjoyment and use of the same by said first party for telegraphic purposes, have permission to build lines under any franchises, contracts, licenses, or rights of way enjoyed or controlled by the party of the first part, or to use any poles, fixtures, structures, or plant of said first party, upon reasonable terms, subject, however, to a revocation of such license to use any poles, structures, fixtures or plant, at any time, by reasonable notice to the party of the second part.

ARTICLE 8. Whereas it is intended as a part of this agreement that all telephones heretofore put out under lease or under license by and from the party of the first part and those it represents shall, without any exception (except temporarily where this contract does not at once apply), become the property of and come under lease and license from the party of the second part, and, when so transferred and placed under lease and license in accordance with the terms hereof, shall not be pursued or treated as infringing instruments in respect of any use thereof prior to the date of this agreement:

And whereas it is also intended that all telephone exchanges which have heretofore been established by the party of the first part or those it represents, or by or under contracts with them or some of them shall, together with their plant, be transferred to the party of the second part and become its property, and that all interests of the party of the first part or those it represents, whether as holders of stock or other interests in telephone exchanges or corporations or organizations owning or maintaining exchanges shall be transferred to the party of the second part and become its property, except in the localities named in section (5) of this article:

And whereas the party of the second part or its predecessors, owners of the Bell patents, have heretofore granted certain licenses, and made certain contracts, exclusive in their character to a certain extent, which may render it impracticable or improper for it to so accept and license some of said telephones and exchanges without the consent of the grantees of such previous licenses who are not parties hereto, and whereas the party of the first part, or those it represents, may not be legally able to transfer some of said property or interests without the concurrence of third parties so that certain of the transfers desired cannot be made, or cannot be accepted and the intended licenses given until arrangements or modifications of contracts can be made with one or both the present licensees claiming conflicting rights (as may be necessary in each case), which will permit the transfers and licenses so intended and desired to be made and granted:

Now, therefore, it is agreed as follows:

(1.) In the places named in Schedule B, hereby referred to, and made part of this agreement, in which places it is understood that no such conflict exists, the exchanges and interests in exchanges owned by the party of the first part, or those it represents, and all the property connected with such exchanges, including contracts of the subscribers, and all telephones in said localities shall forthwith be transferred and delivered to and put under lease or license from the party of the second part and paid for by it as hereinafter provided, except that telephones which already belong to the party of the second part are not to be again paid for. All the interest owned by the Gold and Stock Telegraph Company in the American District Telegraph Company at Boston is to be included in the transfer provided for by this section.

(2.) In the *places* named *in Schedule C* hereby referred to and made part of this agreement, in which places it is understood that the *party of the first part* or those it represents are *sole owners of* all the *exchanges* established and all the telephones put out by or under it or them, but in which the party of the second part has granted licenses which may conflict as aforesaid, the *party of the first part*, and those it represents, *will transfer* all *such exchanges* and telephones *to the party of the second part, who will accept and pay for said exchanges*, and accept, pay for and license said telephones as herein provided, but the party of the second part shall not be required to take, pay for, and license the same as aforesaid, until opportunity has been afforded for the requisite arrangements to be made as aforesaid with its licensees, or it shall elect to accept, pay for, and license the same without waiting for such arrangements to be made.

(3.) This contract shall not operate upon nor affect the telephones and exchanges in the places specified in Schedule D until arrangements have been made with owners or part owners of exchanges therein who are not parties hereto, or until the parties hereto shall agree that it shall operate therein. But the provisions of sections (8) and (9) of this article shall apply to such localities. Upon the transfer of said interests the parties hereto, and those represented by them, will use their best endeavors to to cause all telephones in said localities, which have been manufactured or furnished by or on behalf of the first party, or those it represents to be transferred to and put under license from the party of the second part as aforesaid, and the same shall thereupon be accepted, paid for, and licensed by said party of the second part as herein provided.

(4.) With regard to the price to be paid by the party of the second part to the party of the first part for instruments and all properties and interests to be transferred hereunder, it is agreed as follows: for the instruments specified in Schedule E, hereby referred to and made part hereof, there shall be paid the amounts therein specified respectively, or a proportional part thereof upon the delivery of a portion of said instruments less than the whole number specified, payment to be made upon delivery of the same as herein provided; and in renting such of said instruments as include a transmitter, call bell and switch, being the twenty-two kinds first named in said schedule, the party of the second part may charge a rent or price for the call bell and switch in addition to the standard rent of the telephone itself, and an amount of such additional rental not to exceed three dollars per annum for a period which shall yield an amount equal to nine dollars on each instrument shall be rated as applying to the call bell and switch in said instruments, and on this amount no royalty or bonus shall be paid to the party of the first part. In addition to the sums specified in said schedule the party of the second part will pay the royalties of twenty or twenty-five cents a switch which have been paid on switches included in said schedule and made under contracts with T. B. Doolittle or H. L. Roosevelt. All exchanges which the party of the first part or those it represents have established and own, and all interests, entire or partial, which are to be transferred hereunder, acquired by them in other exchanges or in corporations owning exchanges, are to be paid for when transferred at the actual cost to the party of the first part or those it represents, at the time of transfer, of establishing or purchasing the same, not taking into account any profits or losses in operating the same nor legal expenses in patent suits. Exchanges and exchange plant (which are to be paid for at actual cost), include wires, lines, poles, fixtures and other appliances, and also all call bells, batteries, switches and switch-boards which are in use or on hand fit for use, and are owned and paid for by the exchange, but where the telephone lines have been placed upon poles or fixtures erected for telegraph lines such poles and fixtures are not to be transferred, but the party of the second part may continue to use the same under and subject to the provisions of Article 7. In cases where the value, cost or price remains to be fixed or ascertained, if the same cannot be agreed

upon by the parties hereto, it shall be appraised, fixed or determined by two disinterested experts, one to be chosen by each party; and if the two so chosen cannot agree they shall choose a third, and the decision of the majority shall be binding upon the parties.

(5.) The undertaking of the party of the first part, and those it represents, to transfer all their interests in telephonic district or exchange systems, and corporations or organizations owning them, shall not be held to include the stock interests of said first party and those it represents in the "Philadelphia Local Telegraph Company," "The Central District & Printing Telegraph Company" of Pittsburgh, the "Gold & Stock Telegraph Company of California," the "Michigan District Telegraph Company" of Michigan, which companies have some interests in telephonic exchanges; nor to include their interests in the properties (other than telephones) in the exchanges within thirty-three miles of New York City Hall. The party of the first part and those it represents will, as soon as local conflicting interests can be harmonized, transfer to and put under lease and license from the party of the second part, upon its acceptance and payment for the same as herein provided, all telephones in said New York territory, and in the localities covered by the companies above mentioned, and will use their best endeavors to procure this to be done as soon as possible.

(6.) As to all telephones heretofore put out by the party of the first part or those it represents, for uses for which it or they are entitled to be furnished with telephones as provided in Article 14, they shall transfer the title in the same to the party of the second part, and thereupon shall receive leases and licenses for the same in accordance with this contract, and the party of the second part shall pay for such telephones as herein provided. In all cases where the party of the first part or those it represents are to be licensees of telephones now out and the title in which under the provisions hereof is to be transferred forthwith, they shall begin to pay the rental and royalty thereon and licenses shall issue as from the day this agreement takes effect, and at the present recognized standard rate until some other shall be established in accordance with the provisions hereof. But any such telephone which cannot be so transferred, accepted and and licensed, by reason of conflicting or inconsistent rights heretofore granted by the owners of the Bell patents to their licensees, shall not be paid for nor shall the rent or royalty thereon begin until such conflicting interests can be harmonized as herein provided so as to permit such transfer, unless said second party shall elect sooner to take, pay for and license the same; and until such transfer the provisions of this contract shall not apply to any telephone so situated, and the party of the first part and those it represents shall, in the meantime, stand as they would have done with reference thereto had this contract not been made.

(7.) All telephones, as to the transfers of which special provision has not been hereby made, are to be transferred to and paid for by the party of the second part, and by it licensed directly to customers and users forthwith in the manner and with the effect herein provided, or as soon as practicable as aforesaid.

(8.) With respect to the telephones, and the telephone exchanges and properties and interests the transfers of which may be delayed by reason of conflicting claims or interests as hereinbefore provided, it is agreed that both parties will use their best endeavors and due diligence to arrange with their respective licensees and associates such modifications of existing obligations as will allow said transfer to be made at the earliest possible date. Until such time the parties of the first part will not transfer any of said properties (except so far as existing contracts may legally require them) to any person or party, unless approved by the party of the second part.

(9.) And the party of the first part, for itself and those it represents, agrees that previous thereto any of said exchange properties shall be transferred at said cost price, on request, to any party approved by the party of the second part, who shall not be a competitor in the telegraph business with the Western Union Telegraph Company, suitable provision first being made to protect from oppression the rights and interests of local and associate owners of the exchanges and exchange plant.

(10.) And said first party also agrees that suitable accounts, statements and information shall be seasonably furnished to the party of the second part, for the purpose of, or to assist in ascertaining the price to be paid for all properties and instruments which the party of the second part is to or may take and pay for under this contract.

(11.) Telephones which have been sold by the party of the first part, or those it represents, to institutions of learning and to the Government of the United States, shall be deemed to be licensed by the party of the second part, and shall not be made the basis of any claim for infringement.

ARTICLE 9. As to each locality named in Schedules C and D in which the transfer of the exchanges and telephones may be delayed, as provided in sections (2) and (3) of Article 8, and as to each locality mentioned in section (5) of said article in which the transfer of telephones may be delayed as provided in said article, and as to all telephones (not used on exchanges) in localities where the acceptance of telephones is delayed, as provided in (6) and (7) of said article it is agreed, so far as the conflicting class may extend, that, until the time shall arrive for the transfer for such locality to be made as in said sections is provided, the parties hereto respectively, and the owners or users of telephones or telephonic appliances, claiming or holding under persons whose claims create the conflict and give rise to the delay shall not have the benefit of any immunity or protection from suits by reason of this agreement or anything done hereunder or in consequence hereof, unless and until the parties hereto shall otherwise determine by a writing hereafter to be made; and nothing herein contained shall operate directly or indirectly, expressly or impliedly, as a license to any such person or party to use telephones or telephonic appliances within such locality, nor shall it in any way interfere with or affect the obligations which the parties to this agreement may be under respectively to their said licensees, or with any rights of the first party to supply telephones in such conflicting territories as provided in Article 11. No royalty or bonus shall be paid in respect of telephones used within such localities and not entitled to the protection hereof, unless actually accepted and licensed as provided in Article 10.

ARTICLE 10. (1) All telephones and apparatus which are to be taken, paid for and licensed by the second party hereunder shall be placed under written leases and licenses from it, in such form and at such rentals as said second party shall establish under the provisions of this contract, not different from those at the same time established for other telephones used for like purposes; and the transfer shall not be deemed to be complete nor shall the second party be required to accept, pay for, or license any instrument until it shall be pointed out, ear-marked, and such delivery made of it as the nature of the case will permit. No telephone shall be deemed to be accepted and licensed under the patents of the party of the second part, nor shall any person be entitled to any immunity whatsoever from claims for infringement of any patent by reason of the manufacture or use of such telephone, nor shall it be required to be paid for by the party of the second part until it shall be so delivered and put under written lease or license hereafter to be made, or delivered into the actual possession of the party of the second part, or shall be designated, ear-marked and offered to be put under such lease and license by the parties entitled so to do, including the party in actual possession and the party undertaking and bound to pay rental and royalty therefor. When any telephone shall be so accepted, leased and licensed, or shall be so offered within three months from the date hereof, and, under the provisions of this contract, be required to be accepted and paid for, its manufacture and use, prior to such time, shall not be made the basis of any claim for infringement of any patent.

(2) But the second party may, at any time it sees fit, after the expiration of six months from the date hereof, take from the party of the first part or those it represents any existing telephone (except those which the party of the first part or those it represents are entitled to have and use under the provisions of Article 14, and those which under Article 9 are temporarily excepted from the effect of this contract), with the existing license or contract for license for the same with all the rights of the owner or licensor, by a written notice to that effect given to the party in actual possession of the telephone, and also to the party of the first part, and thereupon it shall be entitled to receive the rental and royalty therefor, and be bound to take and pay for the same as herein provided; in such cases the bonus or royalty to be paid to the party of the first part under Article 1, during the continuance of such existing lease and license, shall be 20 per cent. of the rental actually received under the terms thereof; and in respect of all rights and interests transferred as provided in this article, said second party may, so far as necessary, but at its own expense, use the name of the first party or those it represents, to maintain and enforce all the rights and interest legally or equitably coming to it upon or by such transfer.

(3.) The rental of the telephones transferred or required to be transferred to the party of the second part hereunder shall, from the time such transfers shall be or ought to be made, accrue to and be collected by said second party, subject to the payment and allowance of the royalty, bonus, and commissions hereinbefore provided; when all such transfers have been made, and the conflicting interests of the respective licensees shall have been so far harmonized as to enable said first party to cease to manufacture and supply telephones as provided in Article 11 then said second party will receive and pay for all the remaining property belonging to said Gold and Stock Telegraph Company and American Speaking Telephone Company, of the character specified in Schedule E, at the prices therein stated. All telephones made for use after November 1, 1879, are to be paid for at actual cost when transferred.

ARTICLE 11. (1.) The first party reserves all such rights as it now possesses to continue to manufacture and supply its own telephones, notwithstanding the stipulations of this contract, to its own exchanges already established and in actual operation and subscribers thereto, and to its licensees, until the local conflicting interests between the respective licensees of the two parties hereto can be harmonized and until any property of said first party at such places shall be turned over to said second party and paid for, as hereinbefore provided; but said first party shall organize

no new exchanges, nor grant any new or additional licenses (except to additional subscribers to exchanges already established) creating new or additional conflicts or complications except within the radius of thirty-three miles from New York City Hall, and within the territory covered by the Ormes contract hereinafter referred to; and such places where such conflicting interests of licensees exist shall, until they can be so harmonized, be exempt from the operation of this contract as aforesaid.

(2.) But it is distinctly understood as an essential feature of this contract that all the telephone district or exchange systems except those within the radius of thirty-three miles from New York City Hall, and within the territory covered by said Ormes contract, are to be transferred to and accepted by the party of the second part at the earliest possible day, and that their continuance in the hands of the party of the first part during the meantime, is merely to give an opportunity for local interests to become harmonized and to avoid inconvenience to the public, and not as a source of revenue or advantage to the party of the first part or those it represents.

ARTICLE 12. (1.) The right to all uses of the telephone on wires of a district or exchange system is to remain exclusively with the party of the second part, excepting such temporary suspension of the application of this contract to certain localities, as has been already herein provided for.

(2) For the purpose of this contract it is agreed that an "exchange," or "a district or exchange system" applies to a system in which different stations on the same or different circuits, and either within any city or town or within a radius of fifteen miles of a central office (or within wider limits, where existing contracts have granted wider limits), are connected with such central office or branch offices within said territory for the purpose of placing subscribers or other parties by such circuits in communication with such central or branch offices or with each other, either directly or through the agents of the system.

ARTICLE 13. (1.) The right to connect telephonic district or exchange systems for the purpose of personal conversation between persons at the instruments, and the right to use telephones on all lines not forming a part of a telephonic district or exchange system for such personal conversation (except so far as licenses for private lines are to be granted to the party of the first part under Article 14) are to remain exclusively with the party of the second part, and those licensed by it for the purpose. But such connecting and other lines are not to be used for the transmission of general business messages, market quotations, or news for sale or publication in competition with the business of the Western Union Telegraph Company, or with that of the Gold and Stock Telegraph Company. And the party of the second part, so far as it lawfully and properly can prevent it, will not permit the transmission of such general business messages, market quotations or news for sale or publication over lines owned by it, or by corporations in which it owns a controlling interest, nor license the use of its telephones or patents for the transmission of such general business messages, market quotations or news for sale or publication in competition with such telegraph business of the Western Union Telegraph Company or that of the Gold and Stock Telegraph Company.

(2) The terms "general business messages" and "telegraph messages," or "messages for hire," are defined to mean all communications in behalf of other parties than those who directly communicate by the telephone by themselves or their servants or agents personally present at the instruments; and no person engaged in the business of transmitting messages for other parties shall be authorized or knowingly allowed by the party of the second part, or its servants or agents, to transmit such messages through the telephone.

(3.) It is, however, understood, that the stipulations of this contract relating to the transmission of telegraph messages shall not operate to restrain the renting of telephones by the party of the second part to railroad companies for strictly railroad messages, or for general business messages in connection with the Western Union Telegraph Company or its auxiliary corporations or organizations, nor so as to restrain, impair or affect the right of the party of the second part to use telephones by themselves or their licensees for all purposes in territory not occupied or covered by the Western Union Telegraph Company or its auxiliary corporations or organizations, nor from contracting with the Northwestern Telegraph Company and other companies as to territory not occupied or covered by the Western Union Telegraph Company or its auxiliary corporations or organizations at the time such contracts or licenses are made, or with the Government for lines in the Territories, or for Government lines for Government messages in the States. For the purposes of this contract the Western Union Telegraph Company is deemed to occupy and cover all the thirty eight States of the United States, the District of Columbia and the Territories of Washington and Utah, except the Territory of the Montreal Telegraph Company, to wit, that part of the State of New York which is west of Lake Champlain and north of a line drawn from Whitehall to Oswego, and except the territory of the Northwestern Telegraph Company, to wit, the State of Wisconsin (except the line between Chicago and Milwaukee), the State of Minnesota, that part of Iowa which is North of Sioux City, and the upper peninsula of Michigan, and except all that part of Florida which is not reached by the lines of the International Ocean Telegraph Company or of the Western Union Telegraph Company.

(4) The party of the second part will not knowingly grant any license to use telephones for any purpose for which it agrees not to use them as specified in this article, and it will insert in all its licenses, such apt and suitable restrictions as under the advice of counsel are deemed reasonable and proper to that end and upon notices of any breach thereof will use all reasonable means to enforce the performance and observance of the same. But it is understood that the party of the second part is not to be held responsible for any breach of the stipulations of this article and article 15 of this contract not committed by its officers or servants unless it had reasonable notice and failed to use reasonable means to prevent it.

(5.) The whole expenses of litigation, if any shall arise with third parties in consequence of the stipulations of this article relating to the transmission of general business messages, market quotations or news for sale or publication, or acts in pursuance thereof, or attempts to enforce the same, shall be borne by said Western Union Telegraph Company. Said last-named company shall also have the control of all such of said suits as do not bring in question the validity, construction, or effect of, or title to, the patent rights of the party of the second part, or any of them, whether held by ownership or license, and for that purpose it shall be the duty of said second party to give due authority to such counsel and such attorneys in law or in fact, as the Western Union Telegraph Company may nominate to institute, appear in and conduct such suits, in the name of the second party if necessary.

ARTICLE 14. (1.) The party of the second part will fully license the party of the first part to use telephones procured from it for transmitting telegraph messages, and for use on private lines, with the right to sublet the use thereof along with such private lines, for such purposes as such private lines have been and are being used, except in territories where exclusive agency contracts inconsistent with this agreement to license already exist, and during the continuance of such agencies, in which cases they may obtain them from such agents.

(2.) For the purposes and uses aforesaid, the party of the first part shall be furnished with telephones, with licenses from the party of the second part to use such telephones and other inventions owned or controlled by it for use in connection with telephone lines, on terms which may be established from time to time, and which shall be as favorable as those on which they are furnished to any other parties for like uses, and shall be allowed a discount as provided in Article 2.

(3.) The party of the second part shall have the right from time to time to incorporate in its leases and licenses such apt and suitable stipulations as it may deem requisite for the control, preservation, and protection of its telephones in the hands of licensees, to secure the payment of royalties and rentals, to protect itself against the application and use of telephones for uses different from those for which they are rented or licensed, and to aid it in protecting the patents owned by it or under which it has licenses, and its title thereto, from infringement or attack, and it may prescribe and require the party of the first part to incorporate such stipulations into all licenses, leases and sub-leases of telephones, granted by it; but no stipulations shall be incorporated in the licenses and leases to the party of the first part or prescribed as aforesaid, for the licenses and leases to be granted by it, different from those in use for other licenses for like purposes.

(4) For the purposes of this contract "private lines" are understood to refer to telephone lines, each consisting of a single circuit on which telephones are to be used for the individual and private business of the individuals, business firms, or corporations leasing the same. Such telephones are not to be used by any other parties than those leasing them, except on business of the parties so leasing, nor is any business to be transacted by or through them for a consideration or toll to be paid by other persons than those so leasing them. Such private lines or circuits shall not extend more than twenty-five miles beyond the municipal limits of the city or town in which one end of the line is situated, nor shall any one line or circuit be used for more than two individuals, firms, or corporations at each end, nor shall any two or more lines or circuits be connected.

ARTICLE 15. (1.) The second party will turn over and deliver to the Western Union Telegraph Company of the first part, or its agents, exclusively, all messages for transmission to other points by telegraph, collected by or coming on the wires or within the control of its telephonic exchanges or district systems or those of its licensees, wherever the first party has wires and is prepared to receive or transmit the same, so far as said second party can lawfully control the same, and unless otherwise specially directed by its customer; but will not solicit such special direction nor receive and pay tolls for transmission over other lines, unless compellable by law so to do. And the first party shall forward the same to destination, subject to its established rules and regulations, upon payment of regular tolls, and pay to said second party a commission of fifteen per cent. on all the tolls received for transmitting such messages over its lines; the commission not to include tolls for the transmission over other lines, nor tolls for transmitting

cable messages. For delivery service of telegraphic messages made through said second party or its licensees, and for collecting through a messenger service for delivery to said Telegraph Company, the party of the first part will pay a fair compensation, the same that is paid to district telegraph companies for similar services.

(2.) If the second party, for the purpose of doing a general telegraph or telephone business, shall connect a telegraph station of the Western Union Telegraph Company by a branch line, with any place in territory occupied or covered by the Western Union Telegraph Company which has no Western Union line or office, it shall turn over and deliver to the Western Union Telegraph Company, exclusively, so far as it has legal power to control the same (unless it be specially directed by the customer sending the same that they be forwarded by some other route,) all messages collected from such points so connected. And said Western Union Telegraph Company will, as hereinafter provided, receive, and forward the same upon payment of regular tolls, and pay to the second party or its agents a commission of ten per cent. upon the tolls received for transmitting such messages over the Western Union Telegraph lines (cable messages excepted from such commission); and there shall be added to the rate of tolls to be collected from customers a further rate not exceeding ten cents per message of ten words on such branch lines of the length of ten miles or less, and five cents additional per message of ten words for each additional ten miles or fraction thereof in length of said branch lines, and at the same rate for longer messages; such tolls so added shall belong to the party of the second part.

(3.) When the second party shall have constructed such branch lines to such new points within the territory occupied or covered by the Western Union Telegraph Company, but not theretofore reached by its telegraph lines, and the telegraph company of the first part shall thereafter elect to construct its lines of telegraph to such new points, it shall, if required by said second party, take and pay for the lines of the second party at cost, and also pay said second party the commission provided in section (2) of this article on all the business taken at such point for the period of twelve months thereafter. But if the party of the second part shall elect to keep its own lines, the provisions contained in Article 13, against the transmission of general business and other messages, shall apply to such line.

(4.) Where any messages are to be delivered between the parties through the telephone, said party of the first part is to afford to the party of the second part, at the expense of the second party, the facilities for providing a telephone connection between its office and the office of the district exchange or branch line, and shall at its own office, without further cost to the party of the second part or its licensees, receive or transmit said messages over said connecting line by its own clerks, who for that purpose shall be the agents of the second party and subject to its rules and regulations.

(5.) It is also agreed by the party of the first part, for itself and those it represents, that it will not connect its telegraph lines with any telephonic district or exchange system other than those licensed by the party of the second part, so far as it lawfully can refrain from so doing, except in districts and during the time temporarily excepted from the operation of this contract.

(6.) All messages or communications of customers delivered by either of the parties to the other for further transmission over its telegraph or telephone lines, as the case may be, shall be deemed to have been delivered and received subject to such established rules, regulations and conditions of the receiving company as may have been established and promulgated by it for the government of its business and not otherwise; and for the purpose of regulating and limiting the responsibility of the party receiving from the other a message or communication in this manner, it shall be the duty of the company receiving the message directly from the customer to require his assent to such rules, regulations and conditions of the other company by writing his message or communication upon the regular contract blanks of such company, or blanks containing an equivalent contract, or in such other manner as may be generally required by such company for that purpose from its direct customers; and if either company, dealing with the customer in the first instance shall fail in the duty last above stipulated, it shall hold the other company harmless from all claims for damage which it may be compelled to pay to the customer because of the absence of a contract arrangement with such customer subjecting the business in question to such established rules, regulations and conditions of the company thus rendered liable to the customer; the object of this stipulation being to limit the responsibility of each party to matters happening upon its own lines, and to secure the regulation of that responsibility in respect to all business originating beyond its own lines, in the same manner as such responsibility shall be regulated in respect to business beginning, continuing and terminating upon its own lines. Whenever any such rules, regulations or conditions shall be established or modified by either party the same shall be notified to the other party.

Article 16. The existing suits and interferences shall be disposed of as counsel of the parties of the first and second part may advise, to recognize and protect the rights of the several inventors to their respective inventions, subject to the orders of the courts and the decisions of the Patent Office.

Article 17. This contract shall go into effect as of the first day of November, 1879, and shall be and remain in force until the expiration of seventeen years thereafter. It shall cover the whole territory of the United States, except that included in the Ormes contract (which territory shall be included in this contract upon the expiration of said Ormes contract), and those conflicting localities hereinbefore referred to and temporarily excepted, and shall cover them as soon as those exceptions expire. Said Ormes contract is a contract dated August 26, 1879, to which James M. Ormes, the Western Union Telegraph Company acting for the same parties as in this contract, and the National Bell Telephone Company are parties; the territory covered by it is as follows: West Virginia south of the Baltimore and Ohio Railroad, Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama. For the further contents of said contract, so far as is material, reference thereto is hereby made.

Article 18. (1.) The party of the second part shall keep in regular books for that purpose, accounts of the number of telephones manufactured, licensed, and put out for use in the United States, and also of the rentals received and commissions or allowances paid or allowed as herein provided and of the number manufactured and sold in foreign countries and the amount received therefor. And said accounts shall, at regular quarterly intervals and at all reasonable times be open to inspection by the party of the first part, for the purpose of ascertaining the royalties or bonus due hereunder, and of verifying the accounts rendered, and copies of said accounts shall be rendered at the time of the quarterly accounting. Tolls collected by the one party for the other, and commissions on telegraph business, shall be paid monthly at the place where business is exchanged. All accounts for royalties, and all other unsettled accounts shall be settled, and the balance paid on the first day of February, May, August and November, up to the first day of the preceding month. All such accounts shall be verified by oath of the person having the best knowledge of the facts. Payments of the balances resulting from such accounts shall be made to the treasurer of the Gold and Stock Telegraph Company as representative of the party of the first part, or the treasurer of the second party, as the case may be, or such other persons in Boston or New York as the respective parties may from time to time appoint. Such persons shall have authority to settle all said accounts, and to receipt for the money.

(2.) The party of the first part or its said representative is to be promptly notified of all reduction of rentals.

Article 19. It is understood and agreed that nothing herein contained shall be construed as imposing upon either party any obligation to do or not to do at any time anything contrary to law; and if anything herein covenanted or contemplated to be done or not to be done shall be or become contrary to the law of the land, the consequent inability and failure to perform the same shall not operate as a dissolution of this contract, nor to give to either party a right of action against the other.

Article 20. All the provisions and stipulations herein contained and described as incumbent on or for the benefit of the parties hereto, shall be incumbent on or for the benefit of their respective successors or assigns.

In witness whereof said Western Union Telegraph Company hath caused these presents to be subscribed by its President, and its corporate seal to be hereto affixed by its Secretary, and said National Bell Telephone Company hath caused its corporate seal to be hereto affixed by its Clerk and these presents to be subscribed by its President and Treasurer on the day first above written.

THE WESTERN UNION TELEGRAPH COMPANY,

By Norvin Green, *Prest.*

{ Seal Western Union Tel. Co. } Attest,

A. R. Brewer, *Sec'y.*

THE NATIONAL BELL TELEPHONE COMPANY,

By W. H. Forbes, *Prest.*

Geo. L. Bradley, *Treas.*

{ Seal National Bell Telephone Co. } Attest,

Chas. Eustis Hubbard, *Clerk.*

The above-named Gold and Stock Telegraph Company, American Speaking Telephone Company, and Harmonic Telegraph Company, hereby acknowledge the authority of the Western Union Telegraph Company to represent and act for them in the matters embraced in the foregoing contract, and agree to be bound by and to carry out its provisions, it being understood and agreed by and between said named parties that the royalty and bonus upon telephones, herein provided to be paid to the said Western Union Telegraph Company, shall be paid to the said

Gold and Stock Telegraph Company for the use and benefit of said American Speaking Telephone Company.

IN WITNESS WHEREOF said parties have severally caused these presents to be subscribed by their respective Presidents, and their corporate seals to be hereto affixed by their respective Secretaries on the day of the date of said contract.

THE GOLD AND STOCK TELEGRAPH COMPANY,
By GEORGE B. PRESCOTT, *Vice-Prest.*

{ Seal Gold & Stock Tel. Co. } Attest,
J. D. REID,
Sec'y.

THE HARMONIC TELEGRAPH COMPANY,
By E. W. ANDREWS, *Prest.*

{ Seal Harmonic Telegraph Co. } Attest,
H. H. DUNCKLEE,
Sec'y.

THE AMERICAN SPEAKING TELEPHONE COMPANY,
By NORVIN GREEN, *Vice-Prest.*

{ Seal Ameri'n Speaking Telephone Co. } Attest,
J. D. REID,
Sec'y.

SCHEDULE A.—The royalties which are referred to in (4) of Article 5 are:

A royalty of twenty cents per switch under a contract between the Western Union Telegraph Company and Thomas B. Doolittle, dated June 14, 1879, relating to said Doolittle's patent, No. 209,-115, granted October 22, 1878. The Western Union and Gold and Stock Telegraph Companies have, under said contract with Mr. Doolittle, made and paid him royalty on upwards of 5,000 of these switches.

A royalty of twenty-five cents upon each telephone embodying any of the inventions or improvements covered by the patent No. 218,582, granted to Sidney H. Short, August 12, 1879, under contract between the Gold and Stock Telegraph Company and said Short, dated August 22, 1879.

A royalty of twenty-five cents on each automatic switch which shall be made or used by the party of the second part, under H. L. Roosevelt's patent, No. 215,837, of May 27, 1879, by virtue of the license contained in Mr. Roosevelt's letter to Mr. George B. B. Prescott, dated June 21, 1879.

The party of the second part does not hereby admit the validity, effect, or value of any of said patents.

SCHEDULE B.—Places where the Western Union Telegraph Company or the Gold and Stock Telegraph Company have established exchanges or leased telephones, and the owners of the Bell patents have granted no exclusive rights to other parties, or where the Western Union Telegraph Company or Gold and Stock Telegraph Company have bought the Bell licenses, or interests therein.

No hostile interests are here to be reconciled, and the transfers may take place at once.

1. Places where exchanges were established and are owned by the Western Union Telegraph Company, and on which the telephones of the American Speaking Telephone Company are used: Atchison, Kan.; Akron, N. Y.; Auburn, N. Y.; Boston, Mass.; Chester, Pa.; Concord, N. H.; Danville, Ill.; Decatur, Ill.; Davenport, Iowa; Defiance, Ohio; Evansville, Ind.; Galveston, Texas; New London, Conn.; Houston, Texas; Kansas City, Independence, Mo.; Lafayette, Ind.; Leavenworth, Kan.; Little Rock, Ark.; Moline, Ill.; Meriden, Conn.; Pekin, Ill.; Pittsfield, Mass.; Portland, Me.; Providence, R. I.; Pawtucket, R. I.; Rock Island, Ill.; Richmond, Ind.; Rutland, Vt.; S. Norwalk, Conn.; Springfield, Ill.; Stamford, Conn.; St. Louis, Mo.; Topeka, Kan.; Washington, D. C.

Places where the Western Union Telegraph Company has acquired a part or the whole of the interest of the Bell licensees: Bridgepert, Conn., the whole; Columbus, Ohio, the whole; St. Louis, Mo., majority interest; Providence, R. I., Pawtuckt, R. I., majority interest.

The Gold and Stock Telegraph Company own the telephone exchange in Boston. The stock owned by the Gold and Stock Telegraph Company in the American District Telegraph Company of Boston, is to be transferred with the Boston Exchange.

SCHEDULE C.—Places where the Western Union Telegraph Company, or the Gold and Stock Telegraph Company have established and own exchanges, or have leased telephones, and where the owners of the Bell patents have granted rights to other parties under which those other parties might object to the use of the telephones put out by the Western Union Telegraph Company, or the Gold and Stock Telegraph Company. In these cases, the Western Union Telegraph Company, or the Gold and Stock Telegraph Company could transfer at once, but the interests or obligations of the National Bell Telephone Company require that it shall have an opportunity to arrange with those licensees. Bloomington, Ill.; Dayton, Ohio; Fort Wayne; Syracuse, N. Y.; Fayetteville, N. Y.; Fall River, Mass.; Hartford, Conn.; Indianapolis, Ind.; Keokuk, Iowa; Lockport, N. Y.; Manchester, N. H.; New Haven, Conn., Niagara Falls, N. Y.; Norwich, Conn.; Peoria, Ill.; Rochester, N. Y.; St. Joseph, Mo.; Tonawanda, N. Y.; Trenton, N. J.; Cincinnati, Ohio.

SCHEDULE D.—Places where exchanges have been established, and have used telephones furnished by the Gold and Stock Telegraph Company. (1) Exchanges in which the Western Union Telegraph Company owns a stock interest: Albany and Troy territory, N. Y.; Newburg, N. Y.; Worcester, Mass.; Springfield and Holyoke, Mass.; Cleveland, Ohio; Erie, Pa. (American District Co.); Louisville, Ky. (contract made but no instruments furnished); Denver, Col.; Central City, Col.; Black Hawk, Col.; Golden, Col.; Georgetown, Col.; Leadville.

(2) Exchanges established and using telephones furnished by the Gold and Stock Telegraph Company, but in which neither the Western Union Telegraph Company nor the Gold and Stock Telegraph Company have any interest. Buffalo and Williamsville, N. Y.; Chicago, Ill.; Dubuque, Iowa; Des Moines, Iowa; Milwaukee, Wis.; Toledo, Ohio; Lawrence, Mass.; Quincy, Ill.; Utica and suburbs, N. Y.; Poughkeepsie, N. Y.; Camden, N. J.; Wilmington, Del. *Memo.* The owners of the Bell patents have granted licenses, or made agency contracts for the Albany and Troy district, Worcester, Springfield and Holyoke, Cleveland, the six towns in Colorado, Buffalo and Williamsville, Detroit, Milwaukee.

SCHEDULE E (not printed here) comprises a list of Phelps, Edison, Bergmann, Gray and other styles of receivers and transmitters, etc., several thousand pieces of apparatus being thus transferred at various prices approximating cost of manufacture.

The agreement as above accepted, signed and sealed bears date of Sept. 27, 1879, was approved by the National Bell stockholders on October 24, 1879, and the directors on November 12. It was approved by the Executive Committee of the Western Union Telegraph Co. on November 12, 1879; the directors of the Gold & Stock Telegraph Co. on November 10, 1879; the directors of the American Speaking Telephone Co. on October 30, 1879; and the directors of the Harmonic Telegraph Co. on October 28, 1879.

GENERAL TELEPHONE PROTECTIVE ASSOCIATION.

A meeting of the above Association—the same as has been referred to in previous issues as the Eastern Telephone Protective Association—was held in New York on August 20th, when the organization was completed. The object of this association is to protect its members and their customers from any and all suits that may be brought against them for infringement of the Berliner patent No. 463,569; and the further object of this association will be to reduce the cost of telephone service to the public. The association is now composed of sixteen members. Mr. A. F. Stanley, of Stanley & Patterson of New York is secretary, and also a member of the executive board composed of four members. All the members who have joined so far represent manufacturing companies East of Pittsburgh. The association will immediately employ counsel to go to Boston, to watch the case of the American Bell Co. vs. the National Telephone Mfg. Co., and to assist in whatever way possible in the defence of the Century Telephone Co. and the Bay State Telephone Co., who have also been sued by the American Bell Co.

MUNICIPAL TELEPHONE CRAZE IN OHIO.

A special dispatch of Aug. 18 from Cincinnati says:—Following the craze for water works and electric lights, the smaller cities of Ohio and Indiana are now putting in telephone exchanges. It is a new system, and the city puts in and owns the plant. Chillicothe, Ohio, a town of 16,000 population, has, within a fortnight, completed its plant, and it is working splendidly. The Bell Company left the field. The new company rents the telephones to private residences for $18 a year, while business houses pay $24. The following is the estimated cost of operating the plant, 200 telephones being in operation: Construction of telephones, $10,000; income, 150 telephones, at $18 per annum, $2,700; 50 at $24, $1,200.

FORTY MILES OF SHEEP RANCH TELEPHONY.

The Clark Brothers, whose sheep ranches extend from the Teton river to Birch creek, Mont., a distance of 40 miles, contemplate putting in a telephone extension from a point six miles west of Dupuyer through the latter place on to Pondera, connecting with Fairfield & McCuaige's two ranches, the three ranches of C. R. Scoffin and the two ranches of John Joiner. At Pondera connection will be made with Great Falls. The extension for which the money has already been subscribed will be about

36 miles, which, added to the lines now in use by the Clark Brothers, will make 100 miles of wire. Their principal ranch is on the Muddy and every one of their other ranches is in connection with the home place by telephone. Thus in the severe season all the herders are called up at 4 o'clock in the morning and asked for reports as to the weather, direction of wind, cloudiness and other meteorological data, and when these reports are all digested directions are given for the day's work to the herders. The system is one that has worked with marvelous satisfaction, and many times large bands of sheep have been saved from disastrous consequences by sudden and severe changes in the weather during the winter months.

LONG DISTANCE TELEPHONY IN ST. LOUIS.

Manager Durant, of the Bell Telephone Company, says that St. Louis will be connected by long distance telephone with all the big cities by next spring.

The Bell Telephone Company has received three car loads of copper wire for metallic circuits in St. Louis. The Bell Company has been endeavoring for five years to get authority from the Municipal Assembly to lay conduits. Failing in this, the company has decided to wait no longer, but to string the wires overhead. In order to do this the whole telephone system of St. Louis will have to be reconstructed, and two copper wires, instead of one, strung to each subscriber, thus making a metallic circuit.

The estimated cost of the change is $200,000, $100,000 of which is the cost of changing the central exchanges. There will be four central exchanges instead of two. After the metallic circuit is completed in St. Louis, it will take 60 days to make the long distance connection, the nearest connection being Terre Haute.

GERMAN TESTS OF THE TELEPHONE IN WAR.

An interesting experiment of installing a telephone by trotting cavalry was recently successfully undertaken by some Prussian Uhlans between Berlin and Potsdam. Two sets of one officer and two non-commissioned officers proceeded in the early morning respectively from Berlin to Potsdam. Each set was equipped with a complete telephone apparatus which one of the men carried in a leather case on his chest, besides the requisite quantity of thin wire. The end of the wire was connected with the respective towns' telephone station, and the wire was, by means of a fork fixed at the end of the lance, thrown over the tops of the trees along the road. As each kilometre of wire was thus suspended a halt was made, and it was ascertained whether there was connection with the station. A new kilometre of wire was then connected with the former, and on went the men. The two sets met at Teltow. The wires, having been respectively tested with their respective stations, were connected, and telephonic connection between Berlin and Potsdam was established. The distance is about twenty miles, and the whole thing was done in about four hours.

TELEPHONE NOTES.

SIDNEY, N. Y., is to have a telephone service.

CLARKSVILLE, TENN.—The Clarksville Telephone Exchange is ready to begin business.

GALESVILLE, WIS.—The Galesville-Winona telephone line is to be extended to Ettrick and North Bend.

OXFORD, PA.—The Octoravo Telephone and Telegraph Company has been formed; capital, $50,000.

CHICAGO, ILL.—The Western Union Telephone Company has been formed; capital stock, $100,000. Incorporators—Arthur Dixon, Wilfred Massey and Samuel B. Foster.

LEWISBURG, PA.—The Home Telephone company of Lewisburg has been formed to operate in Union and Northumberland counties; capital, $10,000.

JAMESTOWN, N. Y.—During a severe thunderstorm the switchboard of the telephone exchange caught fire and the apparatus was seriously damaged.

MANISTEE, MICH.—C. T. Ream has been appointed manager of the Manistee Telephone Exchange in place of C. D. Grannis, resigned.

RICHMOND, VA.—A charter has been granted to the Richmond Standard Telephone Company. Their capital stock shall not be less than $100,000, nor more than $300,000, divided into shares of $100 each.

SPIRIT LAKE, IA.—The Spirit Lake Telephone company has sent its articles of incorporation to the secretary of state to be filed. The capital stock is $10,000. Incorporators are W. W. Pritchard, L. H. Farnham, H. E. St. Clair, F. W. Barren, A. B. Funk and seven other citizens.

HONESDALE, PA.—The Citizens' Telephone company expects to have its wires working within a month.

MUSCATINE, IA.—The telephone system here is to be entirely renovated.

SELMA, O.—The Selma Mutual Telephone company has been formed; capital stock, $500.

TIOGA, PA.—The Tioga County Telephone Co. has been formed; capital stock, $1,250.

BARABOO, WIS.—A new telephone system will be built in Baraboo by local capitalists.

CARLTON, TEX.—A movement is on foot to build a telephone line from Carlton to Hico.

MT. PLEASANT, PA.—There has been chartered the Mt. Pleasant Mutual Telephone Co., Westmoreland county; capital stock, $1,000.

LITTLE ROCK, ARK.—The Little Rock exchange of the Southwestern Telegraph and Telephone Company has a new manager—Mr. James A. Chambers, of Dallas, Tex.

MINERAL POINT, WIS.—The Mineral Point Telephone company has been formed; capital, $1,500; incorporators, N. H. Snow, W. R. Smith, Phil Allen, Jr., and others.

NORWICH, N. Y.—Several enterprising citizens are advancing the project of obtaining a telephone line between Norwich and Chenango Lake.

MODESTO, CAL.—The Sunset Telephone company have a crew of men at work making the local connections with the business houses, offices and courthouse and residences in this city.

WAYNE, N. Y.—The Wayne Telephone Exchange have set up their switchboard for the central office in F. R. Freeman's drug store.

PAWTUCKET, R. I.—The officials of the Providence Telephone Company have decided to begin the erection of a building upon the lot on High street the coming fall.

RACINE, WIS., will probably have a new telephone company. It is the Northwestern Telephone and Electric company of Milwaukee. It will use the Ferdinand telephone. One of the organizers of the new company is Mr. J. D. Jillson.

BALTIMORE, MD.—The Chesapeake and Potomac Telephone Company has awarded to Mr. John Hiltz the contract for building an additional story on the telephone building, at St. Paul street.

HUNTINGTON, IND.—Chas. F. S. Neal, Chancellor Commander of the K. of P. of Indiana; Charles N. Zion and Phil Alder of Lebanon, have purchased the Phoenix Telephone Exchange of this city.

OAKLAND, CAL.—The Sunset Telephone and Telegraph Company has issued a new schedule of rates for the long distance telephone service, which shows a great reduction in those which were formerly in effect.

NORTH ENGLISH, IA.—The North English and Green Valley Telephone company have filed articles of incorporation. The principal place of business is at North English, Iowa county. The capital stock is $200.

LOS ANGELES, CAL.—Herman de Laguna has filed an application for a telephone franchise with the City Council. He states that he is representing a competitive company which will lower rates from 50 to 60 per cent.

ELIZABETH, N. J.—The New York and New Jersey Telephone Company, with headquarters at Elizabeth, has decided to equip its inspectors and linemen with bicycles so that they can reach points of trouble on the lines more quickly.

WAUKON, IA.—Articles of incorporation of the Standard Telephone company have been filed at Waukon. The capital stock is $25,000. The incorporators are V. H. Stevens, president; Herman Boeckeh, vice-president; J. J. Dunlevy, secretary; O. J. Hager, treasurer.

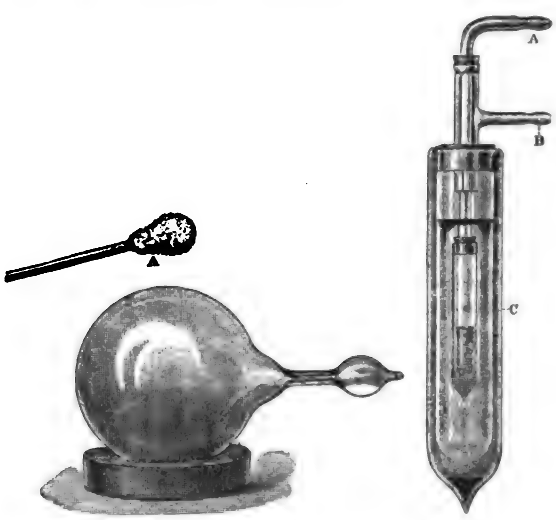
BAY CITY, MICH.—The Common Council has voted to return to the Anthony Telephone Co., of Cincinnati, the certified check for $1,500, which was deposited with the mayor at the time the company was seeking a franchise in Bay City. Under the decision on the Berliner patent case, it is asserted, the company could not carry out its contract with Bay City.

ELIZABETH, N. J.—The Ohio Automatic Telephone and Switch Company has filed articles of incorporation here. The company will begin business with $250,000 capital and will have its start in Elizabeth, with an office in Cleveland, O. The incorporators are Colonel William K. Fogg and William S. Thyng, of Roselle; John W. Lovell, of New York, and Lewis H. Allen, of New Rochelle. The company will make a specialty of the manufacture of the Strowger automatic telephone switch.

SCIENTIFIC USES OF LIQUID AIR.[1]—II.

BY PROF. J. DEWAR, F. R. S.

Here is a globe of the capacity of 1 litre. It has been filled with, presumably, nothing but the vapor of mercury, by boiling under exhaustion and subsequent removal of all excess of liquid. Such a flask ought to contain mercury in the gaseous state that would weigh rather less than one-tenth of a milligramme, assuming the ordinary gaseous laws extend to pressures of less than one-millionth of an atmosphere. Now we know by electric deposition that one-tenth of a milligramme of gold can be made to cover 1 sq. cm. of surface with a fine metallic deposit. Considering the general similarity in the properties of mercury and gold, we should therefore anticipate that if all the mercury vapor could be frozen out of the litre flask it would also form a mirror about 1 sq. cm. in area. But after one such mirror is deposited the renewed application of a second liquid air sponge to another portion of the surface would cause no visible deposit. This is exactly what takes place. If, however, two spheres, one much larger than the other, are joined together by means of a tube about 2mm. in diameter and 50mm. long, the whole space being a Torricellian vacuum (with some excess of mercury) then on decanting, the mercury may be transferred to the smaller sphere, as is represented in Fig. 3. Now if an air sponge is applied to a portion of the surface of the larger sphere, a mercury mirror instantly deposits, but on applying a new air sponge to another portion of the surface, no further mercury mirror is formed. The narrow glass tube prevents the excess of liquid mercury in the small bulb supplying vapor rapidly to the larger one, so that the local cooling to — 180° C. of a portion of the surface has practically condensed all the mercury in the



FIGS. 3 AND 4.

larger space, although the small one is still filled with saturated vapor and a free communication exists between them. If while in this condition the small bulb is inclined so as to allow a drop of liquid mercury to fall into the lower side of the large bulb, which has not been cooled, instant deposition of mercury takes place on the liquid air cooled portion of the upper surface. Under very small pressure of vapor, therefore, equalization of pressure of two bulbs communicating by a narrow tube is a very slow process.

There are cases, however, in which the application of a sponge of liquid air to the surface of a vessel causes no visible deposit, and yet the inference is that something has been condensed. The best arrangement to show this effect is to select highly exhausted vacuum tubes containing phosphorescent materials like alumina and other minerals, and to arrange the induction coil spark gap of a little greater resistance than the vacuum tube. On starting the coil the current passes slowly by the vacuum tube, but immediately the liquid air sponge cools a portion of the surface of the bulb, the discharge shifts to the air-gap. During the cooling the phosphorescence of the glass tube is greatly increased, but finally the resistance may become so great that all discharge in the vacuum tube ceases. Some old tubes belonging to the late Dr. de la Rue have given visible deposits near the electrodes, and in many the diameter and distribution of the striæ are materially changed during the local cooling to —190° C. When large vessels containing nothing but mercury or iodine vapor as a residuum of the vacuum space are rubbed with a cotton wool sponge of liquid air in a dark room, luminous glows filling the vessel take place occasionally, or bright flashes of light which enable the shape of the vessel to be seen. The ordinary mercury vacuum vessels show the same phenomena, which is doubtless due to electric discharges caused by friction and cooling.

The optical properties of bodies cooled to the temperature of boiling liquid air will require long and patient investigation. An interesting fact easily observed is the marked change in color of various bodies. Thus, for instance, oxide, sulphide, iodide of mercury, bichromate of potash, all become yellow or orange, while nitrate of uranium and the double chloride of platinum and ammonium become white. Chromic acid, dilute solution of iodine in alcohol, strong solutions of ferric chloride, and other colored solutions become greatly changed. Such facts are sufficient to prove that the specific absorption of many substances undergoes great changes at the temperature of —190° C.

The tranquil atmosphere of air above the surface of the liquid in cylindrical or spherical vacuum vessels is a convenient place to cool very fragile bodies. During the slow ebullition of the fluid, gas between —190° C. and —180° C. is given off, which has three times the density of ordinary air, and which falls slowly over the mouth of the vessel in a heavy stream. On dipping into this atmosphere small soap bubbles, they contract rapidly and then freeze. If a soap film is made on a circle of thin wire about 3 inches in diameter, and allowed to stand until it shows the various orders of colored bands, and is then carefully dipped into the cool air, it freezes, showing all the original colors. The black band is, however, always broken. Speaking of films, an interesting experiment may be made with a thin stretched sheet of india-rubber, such as is used for making balloons. It is well known that stretched india-rubber contracts when heated and expands when cooled. Now this can be shown very easily by covering a glass funnel or the end of a cylindrical vessel with a stretched sheet of rubber as thin as the walls of balloons. Such a surface is quite flat and fairly transparent. If a sponge of liquid air is drawn across the surface, the course is marked by a series of wrinkles, due to the temporary expansion of the rubber caused by the extreme cold. The sheet of rubber, being extremely thin, soon regains the ordinary temperature, and the surface then is as flat and tense as before. During the continuous motion of the cotton wool liquid air sponge over the rubber surface, it is followed by wave-like depressions, which disappear almost as quickly as they are formed. The elasticity of india-rubber, after cooling to —182° C., and reheating, seems unimpaired.

Organic substances that only become solid at very low temperatures may be divided into two classes: those which crystallize, and those which form glasses. Thus, bisulphide of carbon, tetrachloride of carbon, methyl alcohol, hydride of amyl, all form crystals, whereas ethyl alcohol, amyl alcohol, turpentine, ethyl nitrate, chinoline, picolin, are glass-like. If a few drops of bisulphide of carbon are added to alcohol, and the mixture cooled to —180° C., a white solid emulsion is formed, whereas the addition of tetrachloride of carbon to the alcohol resulted in the production of a clear solid without any separation. In the same way pure methyl alcohol crystallizes easily, but the addition of a few drops of ethyl alcohol prevents crystallization, and causes a glass to be formed. Thus the examination of the behavior of organic bodies at low temperatures may be a fruitful means of organic investigation.

For many purposes of investigation it is necessary to keep liquid air without evaporation. This is readily done by the use of two vacuum test tubes, fitting freely one inside the other, arranged as in Fig 4. The smaller one is filled with liquid air, and after the insertion of an india-rubber stopper and glass tube, is completely immersed in liquid air contained in the larger vacuum vessel. In the figure the tube A connects with the inner vacuum tube and B with the outer. As the latter receives all the radiant and conducted heat, air is continuously boiling off through the tube B; but as the supply of heat is effectually cut off from the inner vacuum vessel, also containing liquid air, no air distills through tube A. This is the most convenient arrangement to use for the production of solid air. For this purpose B is connected with an air pump until the pressure is reduced to about ½ in., and therefore the temperature about—200° C. Then a good air pump is put on to the inner vessel of liquid air (containing oxygen and nitrogen in the normal proportion of oxygen and nitrogen) by means of the tube A, while maintaining constantly the exhaustion in the outer vessel. In a short time the air in the inner vessel solidifies to a transparent jelly-like mass.

TO PURIFY POTTER'S CLAY MAGNETICALLY.

A special dispatch of August 16 from East Liverpool, O., says:—A party of local capitalists is organizing to put into effect a scheme which it is thought will revolutionize two important industries of the Ohio valley. A. C. Wolf and H. A. Whitacre, both of Wellsville, recently brought out an invention for the abstracting of the iron from potter's clay by the use of electro magnets. The new machine has been on trial at one or two potteries and seems to do the work planned for it. The new company proposes to erect a $60,000 factory, which will cleanse the clay of the iron and supply it to the factories. Clay which is now useless owing to the iron in it can be purchased very cheap and the iron extracted. The same thing will be done with the sand used in the glass factories. The glass is often materially damaged by a larger proportion of iron than usual in the sand and there are great beds of the glass sand in Pennsylvania which cannot be used owing to the amount of iron which they contain.

REPORTS OF COMPANIES.

CLOSING OUT THE JAEGER LAMP CO.

Deputy Sheriff Dunphy has sold out the effects of the Jaeger Electric Lamp Company, at No. 154 West Twenty-seventh street New York City, which was incorporated on Feb. 21 last under New Jersey laws with a capital stock of $10,000.

ASSIGNMENT OF THE L DYNAMO CO.

The L Dynamo Company, Limited, a joint partnership organized under the laws of the State of Pennsylvania, has made an assignment for the benefit of creditors to John A. Cass, of Swarthmore, Pa. The deed is signed by John A. Cass, Chairman, and attested by W. E. Jackson, Secretary, and conveys no real estate.

A NEW BUILDING FOR THE COMMERCIAL CABLE.

Mr. Jefferson M. Levy on June 28 purchased the Cutting building, in New Street, New York City, adjoining the Stock Exchange on the south. He already owned the Delmonico and Marshall properties adjoining the southward. On these he announced his intention of erecting a new fire-proof sky-scraper office building. His plan was to incorporate the property and express the value of the new property in bonds and stocks of the corporation. The company which will erect the building has now filed articles of incorporation at Albany. It will be known as the Commercial Cable Building Company, and its capital stock is placed at $1,000,000. John W. Mackay is its President, and other directors and stockholders of the Commercial Cable Company will be in its board of directors. They are: George G. Ward, Albert B. Chandler, William H. Baker, Edward C. Platt, George Clapperton and William W. Cook.

The plans for the new building will be by Harding & Gooch, architects of the Postal Telegraph and other large buildings. They call for a structure in the style of the Renaissance, eighteen stories high, with a dome of three stories more, making twenty-one stories in all, above the basement. The three lower stories are to be in white marble, the rest in gray brick and terra cotta. An arcade will extend through the building from Broad to New Street, and there will be a side hallway from this arcade into the Stock Exchange, it is said. The chief object, however, is to provide a suitable permanent home for the cable operating staff. In the absence of Mr. Mackay, the negotiations have been carried through by Vice-President George G. Ward.

OBITUARY.

W. A. HAMMER.

We regret to note the sudden death, in the White Mountains, at the age of 68, of Mr. W. A. Hammer, the father of Messrs. W. J. and Edwin W. Hammer, both electrical engineers. Mr. Hammer was interested in the management of the Theological Seminary of the Reformed Episcopal Church, at Philadelphia, having been one of the founders of that body and at one time president of its synod. His widow is president of the W. C. T. U. of Pennsylvania.

JASON M. BOWEN.

The death is announced of Mr. J. M. Bowen, president of the Portland, Conn., Electric Light Co., caused by the accidental discharge of his gun while testing it at his summer home on Contentment Island, Conn. He was a graduate of Oberlin College and was 65 years of age.

R. H. GALLAHER.

A well known Wall street man disappears by the death of Mr. Robert H. Gallaher. He was known at one time through his large interest in the Gold & Stock Telegraph Co. and his efforts to get tickers introduced in the stock and banking district.

THE FATE OF ONE MUNICIPAL PLANT TOWN.

A special dispatch of August 14 from Wichita, Kan. says: J. M. Davis, of Greensburg, Kan., who was a member of the dual State Legislature during the memorable sessions of 1893, in an interview to-day stated that the population of that town had dwindled from 2,500 five years ago to 125.

The bonded indebtedness of the city incurred in the establishment of water works, electric lighting and other internal improvements is $45,000. Farmers have bought up the majority of the houses for a song and moved them away, and the handful of people that still remain refuse to pay taxes. The outstanding bonds are worthless.

LEGAL NOTES.

A CURIOUS ELECTRIC LIGHT ACCIDENT.

In Grand Rapids, Mich., Judge Adsit has appointed William S. Walker as next friend of little Florence D. Walker, 8 years of age, in order to commence suit against the Grand Rapids Electric Light and Power Company for $10,000 damages for the loss of an eye of the little child. The declaration states that on last December 28 Florence D. Walker was playing at a street corner when an electric light tender threw a burned carbon from the top of the electric tower, 150 feet, to the ground, striking the child in the right eye, tearing loose the iris, separating it from the ciliary body and destroying her sight. The declaration charges the company with criminal negligence and demands $10,000 damage. The carbon was six inches in length and was thrown, as is substantiated by the fact that it struck thirty-five feet from the base of the tower.

EDISON ENJOINED FROM SENDING KINETOPHONES ABROAD.

At Newark, N. J., on Aug. 20, Vice-Chancellor Emory, in Chancery, listened to an argument in an application for a preliminary injunction restraining Thomas A. Edison from sending abroad any kinetophones. The application was granted.

CURIOUS LIGHTING SITUATION AT BLACKSTONE, MASS.

The electric light company at Woonsocket, R. I., has received a formal order from the Massachusetts gas and electric light commission, ordering it to furnish lights to the town of Blackstone at 42 cents a light instead of 50, the price under the old contract.

The electric light company has refused and the matter will probably be settled in the Massachusetts courts. The curious feature of the situation is that the order from the Massachusetts State Commission is addressed to a Rhode Island corporation.

AM. BELL vs. CENTURY AND BAY STATE COMPANIES.

The American Bell Telephone Co., have entered suit against the Century Telephone Co. and the Bay State Telephone Co., both of Boston, for infringement of the Berliner patent.

MISCELLANEOUS.

THE INCANDESCENT GAS BURNER AND STREET VIBRATION.

REFERRING to the use of the Welsbach light for street purposes, the *Gas World* remarks in a recent issue that "The general opinion among Continental engineers appears to be that while the gas consumption is lessened the cost of renewing mantles more than counterbalances the saving in gas: they admit the better light but recognize no monetary advantage. This may be quite true; and if it is, then what has to be done to make the Welsbach an economical street illuminator is to insure a longer life for the mantles. This might be done in two ways—either by making the mantle less fragile than it is at present, or by introducing some contrivance that would protect it from the vibration inseparable from our public streets; or it may be that the end may be attained partly in the one way and partly in the other. A few weeks ago we briefly described a contrivance introduced by the Incandescent Gas Light Company with the object of protecting the mantle from vibration, the device consisting of carrying the mantle gallery upon three springs. That device, as we then showed, had given very promising results, reducing the mantle breakages by 90 per cent. But even after that great reduction the breakages in the particular case referred to were very heavy, amounting, as our correspondent, 'A Northern Subscriber,' pointed out last week, to almost 29 mantles per annum. To renew a mantle 29 times in the course of a year would, it need hardly be said, be a very heavy burden upon the system. This week we have seen another vibration-absorbing device which promises to give still better results."

AN ILLUMINATED ORANGE TOWER.

Mr. J. A. Gorman, Manager of the California Building, at the Atlanta Exposition, has received from the Chamber of Commerce Los Angeles, a communication saying that an orange tower, thirty-five feet high will be erected in the centre of the building, and will be illuminated by means of three hundred incandescent electric lights. The tower will be covered entirely with oranges, which will be kept fresh during the entire Exposition. For that purpose five carloads of oranges have been placed in cold storage at Los Angeles and supplies will be shipped once every fifteen days to replenish the exhibit.

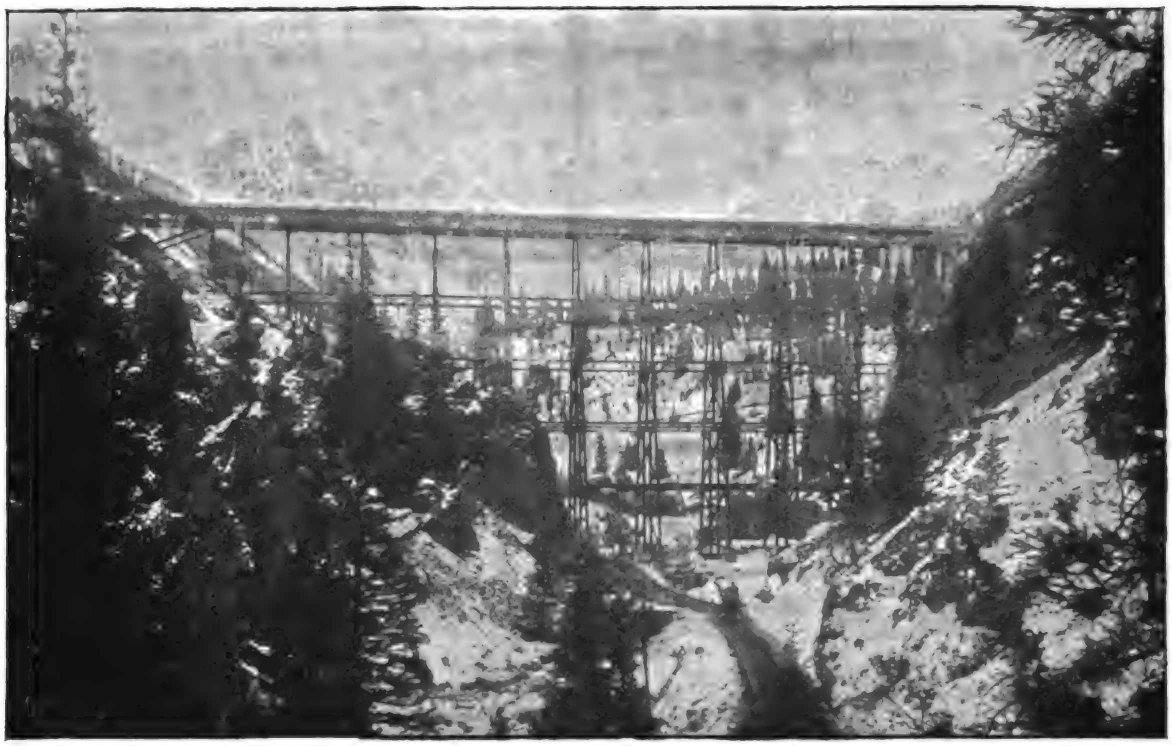


FIG. 1.—FLUME AND TRESTLE, SILVER LAKE MINES, COL., THREE-PHASE TRANSMISSION PLANT.

THREE-PHASE TRANSMISSION PLANT AT THE SILVER LAKE, COL., MINES.

AN interesting application of the three-phase system of long distance transmission of power has recently been carried out at the Silver Lake Mines, near Silverton, Col. where power is transmitted a distance of three miles through some of the roughest country in Colorado. It is attracting considerable attention among mining men, as it is the first three-phase plant installed in the Rocky Mountain region.

The Silver Lake group of mines owned by Edward G. Stoiber, lie about four miles southeast of Silverton, and are situated at an altitude of 12,800 feet above sea level. The ore mined carrie both gold and silver, is of a comparatively low grade and requires concentration. Previous to the installation of electricity, the mill which is situated on the shores of the Lake, near the mouth of the mine tunnel, was run by steam. Coal was brought to the steam engine by a tedious path up the mountain, and by the time it reached the furnace cost $8.75 a ton. This represented a monthly expenditure of almost a thousand dollars, and the expense proved a burden which went far to eat up the profits of the mine. A change, therefore, became imperative.

The plant is now operated by water power, which is brought from the Animas River, above Silverton, through a 8 x 4 foot flume 9,750 feet in length, which carries 2850 cubic feet of water sper minute. The flume and trestle are shown in the accompany-

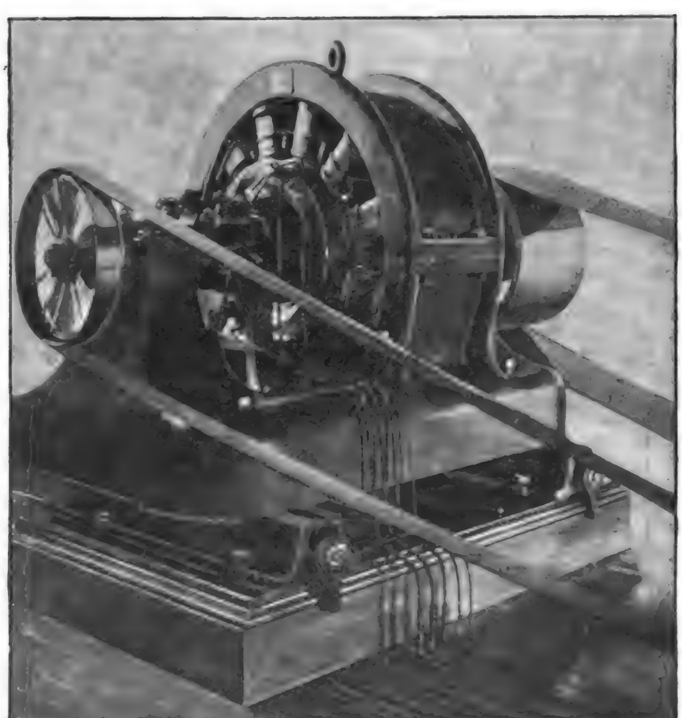


FIG. 2.—THREE-PHASE GENERATOR, SILVER LAKE MINES, COL.

FIG. 3.—POWER HOUSE, SILVER LAKE MINES, COL.

ing engraving Fig. 1. One of the great advantages of electrical utilization is here demonstrated for it was found less expensive to build this costly two mile flume, running from above Silverton down to a spot where the necessary head could be utilized, and then to transmit the electricity back to the mine, rather than to continue to burn coal at the price which it brought at the mouth of the Silver Lake Mines. The head of water obtained is about 180 feet, which develops on the water-wheel shaft 640 H. P.

The plant consists of two 4-foot double-nozzle Pelton water wheels with special buckets belt connected to two 150 K. W. General Electric three-phase generators, one of which is shown in Fig. 2. The current from these machines is delivered at 2,500 volts and is transmitted over a distance a little more than three miles to the Silver Lake mill and mine.

The conductors are No. 3 B. & S. bare copper wires, one for each branch of the three-phase circuits. These are strung from the power house, shown in Fig. 3, up the mountain passes and through the rugged country. In one place where a chasm has to be spanned the wires are strung on poles 275 feet apart. The conductors have been strung with especial care as required by the abnormal conditions. At each insulator the wire is run through a short piece of rubber tube as an extra precaution against leakage. Lightning arresters are placed at each end of the line and an additional safeguard against damage by lightning is provided in the shape of a barbed iron wire which extends the entire distance of the line along the tops of the poles and is grounded at every second pole.

Arriving at the mine the current is supplied to a 100 H. P. three-phase induction motor run directly from the primary circuit. Another 100 H. P. motor, as well as one of 75 H. P. are located beneath the ground and current is supplied to these at a pressure of 220 volts, the reduction in pressure being effected by step-down transformers. In addition, a 15 H. P. motor runs a pump raising water from the Lake to the mill, and one small 1 H. P. motor operates a blower and the lights for a bunk, office and other buildings, both being connected to the secondaries. The General Electric induction motors are used.

The interest in this mine centres, of course, upon the economy effected by the electrical installation. The power used in the mill and the mines at the present time, is more than three times as much as that generated by the steam engine previously employed.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED AUG. 20, 1895.

Accumulators :—

Secondary Battery, F. King, London, Eng., 544,678 Filed Apl. 5, 1895.
Details of construction referring to the shape of the grids and method of maintaining the plates in position.

Alarms and Signals :—

Automatic Electrical Railway Signal, C. R. Alsop, Middletown, Conn., 544,647. Filed Oct. 22, 1894.
Railway Signal, W. B. Vansize, New York, 544,802. Filed July 18, 1895.
The object of the invention is to obviate the effects of atmospheric electricity in the signal circuit and to guard against the mishaps likely to follow the failure of the relay to operate for any reason whatsoever.
Ship's Telegraphic Apparatus, J. K. Adelsberg, Liverpool, Eng., 544,876. Filed Mch. 16, 1895.
Improvements in the arrangements of the magnets.
Fire Extinguisher, W. Harkness, New York, 544,894. Filed Aug. 13, 1888.
A system of automatic electric signals to indicate in which portion of the building the fire is taking place, and also a signal to indicate when the water in the elevated tank has reached a certain point below which it is not desirable to have the water go.
Electric Train Signal, F. C. E. Von Sternberg, Brooklyn, N. Y., 544,987. Filed Apl. 13, 1895.
Specially adapted for elevated electric and cable railways.

Conductors, Conduits and Insulators :—

Manhole for Electric Cable or Other Subways, E. L. Ransome, Chicago, Ill., 544,747. Filed Jan. 11, 1895.
Consists of a movable shield, hood, or cover in combination with the chamber of the manhole, for the purpose of protecting the electric wires or cables where they are placed about the walls within the manhole chamber.
Insulator for Electric or Other Wires, C. Sproat and E. N. Tarr, Taunton, Mass., 544,778. Filed Jan. 2, 1895.
Insulator is in two screw parts which hold the wire in place without tie wires.
Insulator, R. G. Collins and F. W. Foley, Dollar Bay, Mich., 544,930. Filed Feb. 25, 1895.
The wire is fastened without being bent at the place where it is supported by the insulator.

Dynamos and Motors :—

Electric Motor, B P. Remy, Peru, Ind., 544,749. Filed Nov. 24, 1894.
The motor has an armature of the radial pole type revolving in an elliptical field magnet frame.
Carbon Brush Holder for Dynamo Electric Machines, A. J. Churchyard, Brooklyn, N. Y., 544,844. Filed May 14, 1894.

Electrometallurgy :—

Apparatus for Electroplating, F. and F. H. Engelhard, Springfield, Mass., 544,663. Filed March 23, 1892.
The anode and cathode are continually revolved.

Miscellaneous :—

Dynamometric Governor, W. N. Smith, Chicago, Ill., 544,696. Filed Aug. 16, 1894.
The combination with a prime motor and a dynamo operated thereby and supplying an electric circuit, of air compressing mechanism connected with and operated by the prime motor and an electrical dynamometer lying in said circuit and connected with and controlling the operation of said air compressing mechanism, whereby the rate of compression of air thereby may vary with the current passing through the dynamometer.
Electrically Controlled Weighing Machine, L. H. Nutting, Davenport, Ia., 544,745. Filed Nov. 13, 1894.
Applying Power at a Distance by Means of Electricity, J. F. McLaughlin, Philadelphia, Pa., 544,861. Filed Oct. 8, 1891.
Apparatus for stopping machinery at a distance. Clutches are released by means of an electric motor.
Operating Throttle Valves of Engines, C. H. Silverwood & J. Fraser, Philadelphia, Pa., 544,867. Filed May 21, 1895.
Apparatus for automatically closing throttle valves of engines and other motors from a distance.
Electrically Controlled Winding Mechanism for Time-Locks, W. H. Hollar, Philadelphia, Pa., G. L. Weaver, Boston, Mass., and A. Kennedy, Charlestown, W. Va., 545,020. Filed Apl. 1, 1895.
Electric Winder for Time-Locks, W. H. Hollar, Philadelphia, Pa., G. L. Weaver, Boston, Mass., and A. Kennedy, Charlestown, W. Va., 545,021. Filed Apl. 17, 1895.
Permits the rewinding of the clock movement of the time-lock without opening the safe or otherwise exposing the lock mechanism.

Railways and Appliances :

Trolley Arm and Attachment Therefor, G. Maag, Newark, N. J., 544,677. Filed Dec. 12, 1894.
Device to restrain the trolley wheel from jumping the trolley wire.
Electric Locomotive, E. H. Porter, Radford, Va., 544,685. Filed June 22, 1894.
The armature transmits motion by means of a crank and a connecting rod, and the speed ratio of transmission can be varied.
Automatic Safety Trolley, J. B. Scranton, New Haven, Conn., 544,774. Filed Mch. 30, 1895.
Trolley Arm and Wire Finder, F. W. Riess, Philadelphia, Pa., 544,794. Filed June 10, 1895.
Electric Railway, J. F. McLaughlin, Philadelphia, Pa., 544,862. Filed Apl. 17, 1895.
Has reference to improvements in electric railways in which exposed contacts on the surface of the road-beds are coupled to a buried supply conductor by underground switches operated by magnetic attraction from the motor car.
Electric Railway, J. F. McLaughlin, Philadelphia, Pa., 544,863. Filed May 8, 1895.
An underground switch which will be positively locked when in the open position, and which will be unlocked and closed only when covered by a motor car.
Trolley, G. W. Biddell, Chattanooga, Tenn., 545,009. Filed Feb. 2, 1895.

Switches, Cut Outs, etc. :—

Electric Elevator, N. O. Lindstrom, Union Course, N. Y., 544,768 Filed May 16, 1895.
A switch especially adapted for operating and controlling elevators.
Electric Switch, T. H Brady, New Britain, Conn., 544,781. Filed May 8, 1895.
One of the contact jaws is pressed against the knife blade by a spring.
Multiple Electric Circuit and Mechanism for Maintaining Same, T. K. Ames & E. A. Parker, Peterborough, N. H., 545,005. Filed Oct. 19, 1894.
Device whereby an electric current may be caused to supply in succession a number of independent circuits. A distributing switch.

Telephones :—

Telephone Switch and System, E. C. Wilcox, Meriden, Conn., 544,711. Filed May 13, 1895.
A hand operated transmitter switch.
Magneto Electrical Telephone, M. Frank, Munich, Germany, 544,890. Filed June 30, 1894.
The permanent magnet is surrounded by a steel shell acting as a handle, and forming a closed magnetic circuit.
Telephone-Exchange Apparatus, J. J. O'Connell, Chicago, Ill., 544,901. Filed Apl. 29, 1893.
When the operator shifts a key to throw her head-telephone into or out of a subscriber's circuit the signal at the chief operator's desk indicates such fact.

THE GROWING USE OF MEDBERY FIBERITE.

MR. H. J. MEDBERY, President of the Fiberite company, manufacturers of the Medbery overhead material and other specialties, has just returned from Chicago, and reports a most encouraging outlook for the trade in that section of the country. He feels assured that his company will be able to secure a good share of the business. For several years Mr. Medbery has held to his determination to make the highest grade of overhead material possible. The fact of there being a large quantity of cheap material used, has tempted him at times to compete with such material, but he had sufficient pride in the name of "Medbery" and faith enough in the future of good, honest material, to refuse to go far into such lines. His company is now reaping the benefit of his determination to make "the highest grade material only." Mr. Medbery states that roads "all over the country, and almost without exception, are demanding material which has been tried, and found equal to the severe conditions of an electric road." The company has confidence enough in its material to give the purchaser an absolute guarantee, although wherever the Medbery has been used, such guarantee is not necessary. Honorable business methods, combined with honest goods, has resulted in the factory of the Medbery Company being rushed to the utmost to fill orders. The Medbery Company is represented in New York, Chicago, San Francisco, Philadelphia and other cities by concerns of well-known standing, and orders are filled at once from stocks carried at these agencies.

NIGHTINGALE, JOHNSON & CO.

MR. WALTER H. MORTON, formerly foreman of the Testing and Expert Department, General Electric Co., Schenectady, N. Y., has been admitted to full partnership in the firm of Nightingale & Johnson, electrical engineers and contractors, Utica, N. Y., and the firm will continue its rapidly increasing business under the name of Nightingale, Johnson & Co.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE DEMAND FOR BEACON INCANDESCENT LAMPS.

The Beacon Lamp Co. of Boston, report having closed a contract with the Boston Electric Light Co. for 9,000 lamps, to be used in connection with the Knights Templars' decorations, in which some of the pieces require several hundred lamps, the idea being to outdo any previous efforts in this direction. Keith's Theatre has ordered 1,000 special lamps for the same purpose.

The Beacon Co. have also been awarded the U. S. Government contract for 10,600 lamps for the Brooklyn Navy Yard, so that altogether with its regular run of orders the company is quite busy.

ACTIVITY OF THE WESTINGHOUSE MACHINE CO.

The Westinghouse Machine Company reports business active and the outlook very flattering. Orders for compound engines the past month, include one 250 H. P. to Whittenton Mfg. Co., Taunton, Mass.; one 100 H. P. and one 125 H. P. to American Hydraulic Dredging Co., East Douglas, Mass.; one 80 H. P. and one 100 H. P. to Sioux Consolidated Mining Co., Mammoth, Utah; one 200 H. P. to Wendell & Smith, Overbrook, Pa.; two 80 H. P. to Upper Peninsula Hospital for the Insane, Newberry, Mich.; four 250 H. P. to United States Capitol Building, Washington, D. C.; one 250 H. P. to Connellsville Electric Light Co., Connellsville, Pa.; one 250 H. P. to Belvidere (Ill.) Electric Company; three 160 H. P. to Carnegie Library Building, Pittsburg, Pa.; one 125 H. P. to Hackensack (N. J.) Gas & Electric Company; one 300 H. P. to Wilkinsburg (Pa.) Electric Company; one 250 H. P. to Sing Sing (N. Y.) Electric Company; one 200 H. P. to Gloversville (N. Y.) Electric Company. In addition to the above, the increased number of orders for "Standard" and "Junior" automatic engines, indicates a general revival in all branches of manufacturing.

TELEPHONES FOR THE NAVY DEPARTMENT.

The Navy Department, through the Bureau of Yards and Docks, is inviting proposals until September 16, for telephones and switchboards.

THE "ELECTRA" NUERNBERG CARBONS FOR THE ATLANTA EXPOSITION.

MR. HUGO REISINGER, of 38 Beaver Street, New York, sole importer of the "Electra" Nuernberg Carbons, informs us that the contract for the supply of high grade arc light carbons, for lighting the Atlanta Cotton States and International Exposition, has been awarded to him.

Mr. Charles F. Foster, the engineer of the Departments of Machinery and Electricity, in his requirements, states that the carbons must be first-class in every respect; and being for exposition work, should burn as perfectly as possible.

After having made an exhaustive test of various other imported carbons, Mr. Foster decided to adopt the "Electra" carbon, it having proved far superior to any other carbons tested.

NEW YORK NOTES.

MR. J. H. VAIL has been appointed Consulting Electrical and Mechanical Engineer to the State Mutual Life Assurance Company, Worcester, Mass., and is now preparing plans and specifications for a complete steam and electric plant of the best type for the service required.

MR. H. W. WELLER, C. E., E. E., late of the General Electric and Columbian Electric Companies, has been appointed manager in New England, with headquarters at Boston, for the Campbell & Zell Co., the makers of the Improved Zell Safety Water Tube Boiler, a plant of which has just been ordered for the Tremont Temple, Boston.

MR. FREDERICK NOLL, late of the firm of Noll & Sibley, has joined the forces of the Interior Conduit & Insulation Co., and will manage the sales of their dynamos, motors, fans, conduits, etc., for the metropolitan district of New York. He has been actively connected with the electrical trade in this vicinity for fifteen years and enjoys a large friendship and acquaintance.

THE ABENDROTH & ROOT MANUFACTURING COMPANY has of late filled a number of notable orders for their improved Root water tube boiler, principally in New York City and vicinity. It may be mentioned in this connection that Arthur Loretz, Jr., formerly New York manager for the National Water Tube Boiler Co., is now representing the "Root" boiler at 28 Cliff street, New York City.

WESTERN NOTES.

MR. H. J. MEDBERY, Pres. of the Fiberite Co., Mechanicville, N. Y., was a recent visitor to Chicago where he was heartily welcomed by his many friends.

THE RACINE HARDWARE CO., of Racine, Wis., are still very busy, and are shipping quite a number of their well known vertical and horizontal engines.

THE BELDING ELECTRIC ALARM MAIL BOX CO. report a good business. They have placed their boxes in several of the new buildings in Chicago, and are also receiving some nice orders from various parts of the States.

THE ELECTRIC APPLIANCE COMPANY has secured some very handsome orders for Upton Arc Lamps for which they are General Western Agents. The alternating lamp with their patent "anti-hum" cover is proving very popular, as it does away almost entirely with the noise of the lamp, which has always been such an objectionable feature in alternating lamps.

THE ELECTRIC APPLIANCE COMPANY is sending out an advertising novelty in the shape of a printed wiring table that can be cut to fit inside the cover of a watch case and is known as the Wells Watch Case Wiring Table. The Company has sent out several thousand of these and will be glad to receive applications from any of the trade that have not received them. They are mailed free on application.

THE METROPOLITAN ELECTRIC COMPANY, Chicago, have been appointed selling agents for the Coe Electric Alarm Mail Box. This box is the latest improvement in the postal service. By a simple device the act of inserting the letter rings the house bell a predetermined length and number of times, thus distinguishing the postman from a caller. It requires no extra wiring, battery or bell. The Metropolitan Company state that they are in position to fill orders for this box in three different styles and in any finish.

WISCONSIN RIVER.—The new mills of the Grand Rapids Pulp and Paper Co., at Bearin, on the Wisconsin River, is being rapidly pushed forward. The company is constructing a dam, excavating a large mill pit from solid rock, and erecting large substantial brick buildings. They have contracted with The James Leffel & Co., of Springfield, Ohio, for 15 of their large Samson turbine water wheels, which will be in position in November. All the work is being done upon the most approved plan, and is of the most substantial character.

MR. L. A. FARNSWORTH, Chicago manager for the Automatic Circuit Breaker Co. of Newaygo, Mich., has just returned from a trip through Michigan and Wisconsin and reports a number of good orders for their circuit breaker. He thinks that the outlook for the future business is very promising. Mr. Farnsworth is located at No. 937 Monadnock Bld. and will always carry on hand a full line of circuit breakers so that all orders will be filled on short notice. The new catalogue entitled, "Protection For Sale" is now in press and will be cheerfully given to all who ask or send for it.

PHILADELPHIA NOTES.

THE PENNSYLVANIA ELECTRIC ENGINEERING CO. has been awarded the contract for the complete wiring and construction work for the Fidelity Mutual Life Association building at Broad and Arch Sts. The specifications call for a plant of 3,000 light capacity. General Electric dynamos and M. A. Greene engines will be used.

NEW ENGLAND NOTES.

BROWN & SHARPE MFG. CO., of Providence, R. I., have issued in very complete form their 1895 catalogue and price lists. The volume is necessarily bulky, covering, as it does, their many departments, among which are machinery, sewing machines and iron castings. The illustrations also include milling, grinding, screw and tapping machines, vertical and horizontal chucking machines, gear cutting machines, engine and hand lathes; also a full list of articles for cotton and woolen manufacturers' use.

THE DELAWARE HARD FIBRE CO. of Wilmington, Del., has secured the contract just awarded for supplying the General Electric Co. with fibre. They are the largest consumers of this material in the world and their trade is the big thing in the fibre line. The Delaware Hard Fibre Co. have recently more than doubled the size of their plant and are running day and night.

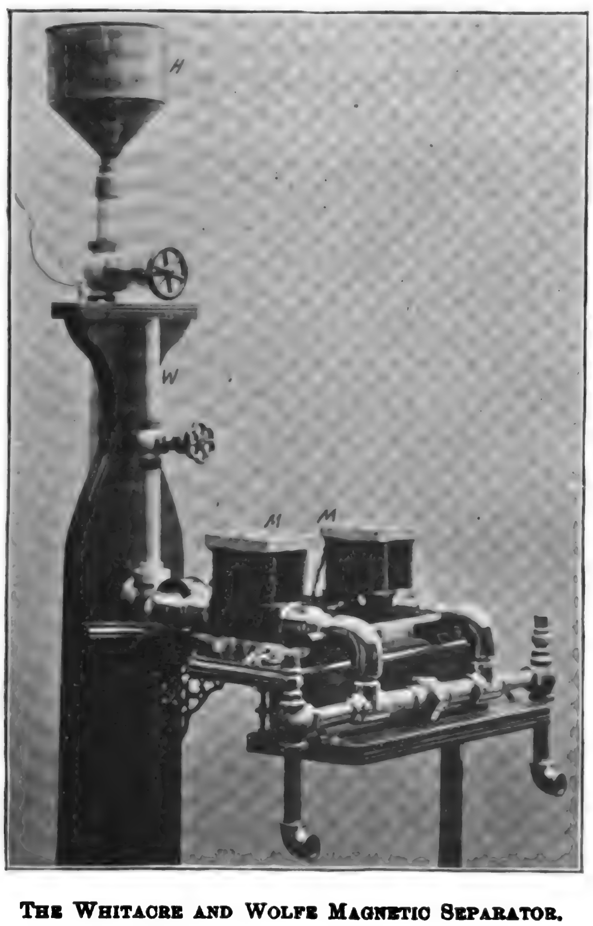
☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.

Vol. XX. SEPTEMBER 4, 1895. No. 383.

THE WHITACRE-WOLFE IRON SEPARATOR FOR CLAYS AND ORES.

DEPOSITS of clay are found in many localities but there are comparatively few that are sufficiently pure to permit of their being used for pottery ware. The most common impurity met with in clay is iron, and the endeavor to remove this has called forth a variety of devices. A magnetic apparatus naturally suggests itself immediately to accomplish the desired object, but the nature of the



THE WHITACRE AND WOLFE MAGNETIC SEPARATOR.

material to be handled calls for special treatment, as even a small trace of iron will make its presence known in the pottery ware when finished With these difficult conditions in mind, Messrs. Whitacre and Wolfe, of Wellsville, Ohio, have recently completed and put in operation the separator illustrated in the accompanying engraving, the construction of which will be readily understood.

The material to be purified is fed into the hopper H, in the form of "slip" or liquid, and passes down the pipe to a tee, from which two branch pipes proceed, one going horizontally to the right, and one to the left. At the point where each branch starts, it is surrounded by a coil having a hollow soft iron core with pole pieces. One of these coils is seen in the illustration at C. The pipes then make a bend and pass forward through the magnetic fields produced by the bipolar magnets M M and then bend downwards like faucets, the material passing off through the pipes shown.

The clay fed into the hopper, passes down the pipes, which are all of brass, 2 inches in diameter, and as it reaches the coils C the iron particles held in suspension are retained. Such particles as are not held by the coils C then come under the influence of the magnets M M, which successfully retard their progress.

When sufficient iron has been extracted to necessitate a cleaning of the machine, the current is cut off from the coils and magnets, and all the valves are closed except the one leading to the pipe which conveys the extracted iron to the sewer. The pipes and accumulated iron are then readily cleaned by the wash-out pipe shown at W. This pipe can also be used for tempering the material to any desired consistency, while the machine is in operation, by permitting more or less water to pass through.

In order to guard against a failure of the current and hence accidental demagnetization of the magnets, an alarm is arranged to give a signal by the closing of a local bell circuit.

The separator, which is the joint invention of Mr. W. W. Whitacre and Mr. A. C. Wolfe, has already been at work and is pronounced highly efficient by the leading potters in the largest pottery district of the country. We understand that the machine is also to be used in the magnetic purification of gold, silver and copper ores, and in the extraction of iron from the sand used for glass making.

THE DURABILITY OF PORCELAIN AS AN INSULATOR.

BY A. B. DOBBS.

As an insulator, porcelain is a great deal tougher and more lasting than glass, and, while new, a higher insulation is claimed for it even when covered with dust and smoke. But in an experience extending over several years with all kinds of insulators, I have noticed that the glazing on the porcelain seems to crack when exposed to the weather.

A case of this kind came under my notice about two years ago. The original telegraph line from Montreal to Vancouver is strung on porcelain insulators of the same size and shape as the glass insulator, known in this country as the W. U. double petticoat pattern. Upon inquiry I was told that the porcelain insulators were not considered as good as glass (all the other wires on the line were tied to glass). I could see for myself that the wire in contact with the porcelain in many places left red streaks of rust upon it, proving that either the porcelain contained some deleterious substance, or that there was slight electrolysis, caused by leaks. The insulators were also seamed and badly cracked. In justice, however, I will say that the porcelain appeared to me to be of Canadian manufacture, which is of a very inferior quality.

It will be interesting to learn how porcelain insulators that have been in place from five to ten years have behaved; the record to include the condition of the climate in which

they are worked and whether of American or foreign manufacture.

There is a growing impression, that for high voltages at least, porcelain is better than glass; but *is* it?

THERMO ELECTRIC CURRENTS FROM GALENA.

BY AN EXPERIMENTER.

In the old table prepared by Prof. Cumming showing the position of the various metals in a thermo electric series, galena is placed at the head of the list as being positive to all others. It was also used by Clamond, Stefan and probably by others for the positive element of thermo electric batteries. It is undoubtedly true that it almost invariably does give a positive current but still specimens have been found that are sometimes positive and sometimes negative. This being the case, it becomes an interesting question as to what causes the reversal of the current and under what conditions it can be made to give a positive or negative as desired. With this object in view the following experiments have been made and repeated many times with the same result every time.

A strip of lead foil about four inches long, one inch wide and two one-hundreths of an inch thick, was covered on one side with finely powdered sulphur and rolled up into a solid cylinder about one inch long. It was then put into a glass tube the inside diameter of which was just large enough to allow it to fit inside loosely. The tube was then heated over a Bunsen burner. Part of the sulphur combined with the lead, which became red hot from the heat caused by the chemical action. The rest of the sulphur was melted and partly vaporized. It was then removed from the flame and after a while the lead was pushed out of the tube and was found to be a somewhat porous mass of lead sulphide or artificial galena, thoroughly saturated with sulphur.

A piece of platinum wire was then melted into one end of it and connected to a galvanometer. Another platinum wire also connected to the galvanometer was pressed against the other end and heated red hot. It gave a negative current flowing from the hot wire to the sulphide. It also melted the sulphide and decomposed it, the released sulphur burning off and the lead recombining again with the free sulphur on the cold side. This action was constant as long as the sulphide was saturated with sulphur, but the heat gradually drove off the free sulphur and then the current reversed and flowed from the sulphide to the hot wire.

A cylinder of sulphide was then made in the same manner as before and placed in a glass tube, the inside diameter of which was somewhat larger than the cylinder, so as to allow a free passage to the air. The tube was then held over a flame and all surplus sulphur driven off. It was then connected to the galvanometer and tested as before and at once gave a positive current flowing from the sulphide to the hot wire. In this case the oxygen of the air probably combined with the sulphur which passed off as sulphurous acid and also with the lead, forming an oxide. This oxide was then decomposed by the hot wire, the lead flowing out on to the wire and the oxygen combining with the sulphide on the cold side. Litharge, when melted and formed into a cylinder and tested in the manner described above also gave a positive current. It was also decomposed, the melted lead flowing out on to the hot wire.

A piece of natural galena was tested with the hot wire and found to give a positive current. It was then heated in melted sulphur and when tested again gave a negative current for some time, but after the heat had expelled the sulphur the current reversed and became positive again.

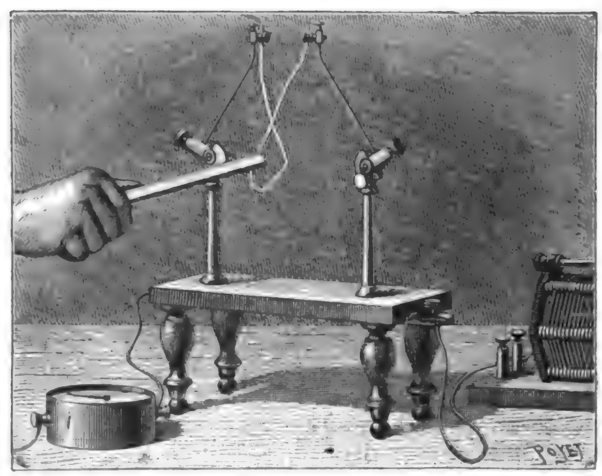
A cylinder of the sulphide saturated with sulphur was pressed against one end of a short piece of platinum wire about $\frac{1}{8}$ of an inch in diameter, and another cylinder, from which the surplus sulphur had been expelled, was pressed against the other end, and, the wire between the two being heated red hot, a positive current flowed from the cylinder from which the sulphur had been expelled, to the hot wire; and a negative current from the hot wire to the cylinder which was saturated with sulphur. These two currents joined together and doubled the electromotive force and also confined the heat of the wire so that it could not escape at either end without giving up its equivalent in current.

These experiments would seem to show that the action is the same as in any voltaic cell, the direction of the current being determined by the nature of the chemical action which takes place under the varying conditions.

No attempt has been made to measure the electromotive force of the current, but the cylinders of sulphide will be gladly furnished all ready for testing to anyone who has the facilities for making exact measurements and who may wish to do so.

ACTION OF THE ELECTRIC CURRENT ON ALUMINUM WIRE.[1]

If an aluminum wire has a current passed through it sufficiently strong to heat it beyond the point of fusion it is observed that it can be carried to a white heat and maintained in this state, contrary to what is observed in other metals submitted to the same test, which, when their points of fusion are obtained melt instantly, each end of the ruptured wire presenting the form of a small metallic



EXPERIMENT WITH HOT ALUMINUM WIRE.

globule produced by the contraction due to the surface tension of the liquefied metal.

Aluminum behaves very differently. If the wire be originally strung taut between the two supports that carry the current, it sags heavily, but can remain quite a long time in a state of complete incandescence up to the moment of rupture, which generally takes place close to the clamps. The aluminum wire evidently consists of a liquid thread which oscillates at the slightest breath, and is maintained in the air by the cohesion of its molecules, and probably also in virtue of the formation of a very thin skin of alumina, which acts the part of an infusible protecting coating around the fused metal. This coat must in any case be very thin, for microscopic examination does not show very strong indications of oxidation.

The results of a series of tests carried out in air with aluminum wires of different lengths and diameters show that the aluminum conveys rapidly to the supports a part of the heat liberated, and that for decreasing lengths of wire increasing current strengths are required to bring them to the same temperature. Thus, for example, it was shown that a filament of aluminum 0.5 mm. in

1. Abstract from *La Nature*.

diameter is able to convey the very extraordinary current of 31 amperes, at which point it is at a reddish white heat. The resistivity of the wire increases in a rapid ratio, since for the same wire, the difference of potential at the extremities is almost zero at the start, with the current hardly sufficient to heat the metal appreciably, but increases rapidly, reaching the value of 5 volts, when a white heat is attained.

The mobility of the aluminum wire at a white heat is well shown by the experiment illustrated in the accompanying engraving. A wire 25 to 30 centimetres long and 0.3 mm. in diameter is arranged so that its lower end can be given a turn. This turn, when current passes, is extremely sensitive to the approach of a straight magnet, and depending upon the direction of the current, the pole of the magnet is violently repelled or attracted. In general—and it is at this point that the experiment becomes the most attractive—the repulsion changes into sudden torsion of the wire on itself, which tends naturally to present to the pole of the magnet the side in which the direction of the current is such that attraction is produced. The experiment however, is of short duration, for at this instant, the rapid twist brings the two sides of the turn in contact, and in consequence short circuits the part of the wire below the contact point. The result is a rapid increase of the current which instantly fuses the wire.

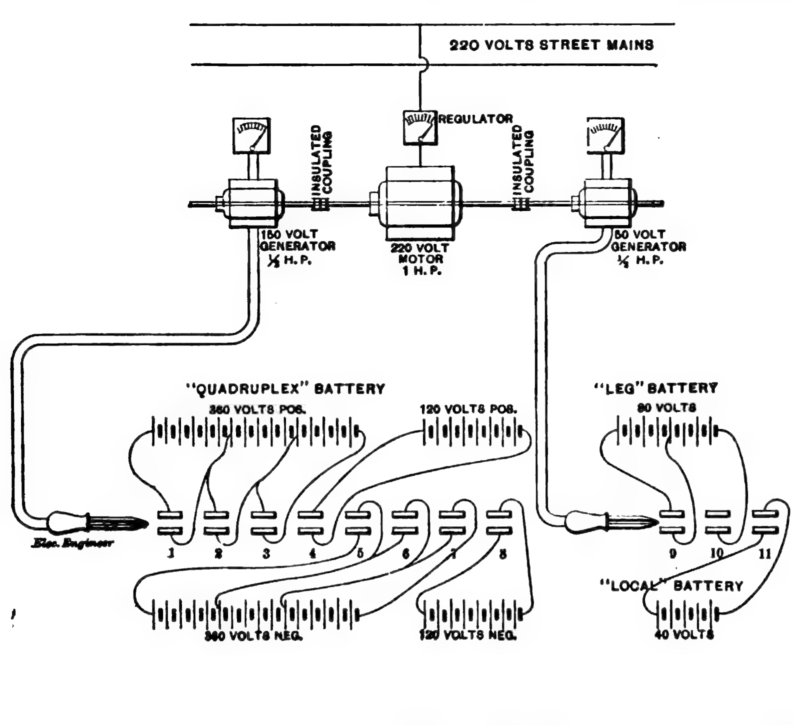
ELECTRICAL UTILIZATION OF THE RHONE AT LYONS, FRANCE.

Last spring the Société Lyonnaise des Forces Motrices du Rhône opened a competition for the best scheme of the utilization of the water power of the River Rhône (20,000 horse power) on the Canal du Touage, to supply the town of Lyons with the electric light and electrical power for industrial purposes. The jury, consisting of Professor Galileo Ferraris, of Turin, Eric Gerard, and R. V. Picou, accorded the first prize to the scheme submitted conjointly by the Compagnie de l'Industrie Electrique, of Geneva and Paris, for the electrical part; and Messrs. Escher, Wyss & Co., of Zurich, for the hydraulic part. It will be remembered that both these firms obtained prizes for their scheme of the utilization of Niagara Falls.

SOME APPLICATIONS OF STORAGE BATTERIES.

R. Macrae

The present activity in storage battery industries and the rate at which these cells are taking the place of primary batteries for the operation of telegraph, telephone, police, fire, burglar alarm and similar systems, not to mention their application to central station lighting and power plants, is particularly gratifying to those who have never doubted that the invention of lead batteries marked one of the most important epochs in the history of the practical application of electricity. The fact that even the poorest type of lead battery that has been on the market in this country was capable, if properly installed, of giving better service for the class of work above mentioned than the best type of primary battery, is sufficient to show that the unfavorable opinion until recently held by the public regarding storage batteries was due not so much to defects in the batteries themselves as to mistakes made in the manner of applying them In addition to the decided improvements that have recently been made both in the construction of lead batteries and in the process of manufacturing them, it has also been recognized that fully as much depends on knowing how to make use of these batteries as on having a good type to begin with. This applies more particularly to the manner of installing the battery and the selection of a battery adapted to the character of the work to which it is applied. Once properly installed, the directions for taking care of a battery are so simple and the attention necessary is so little, that it is almost impossible to fail in getting satisfactory results.



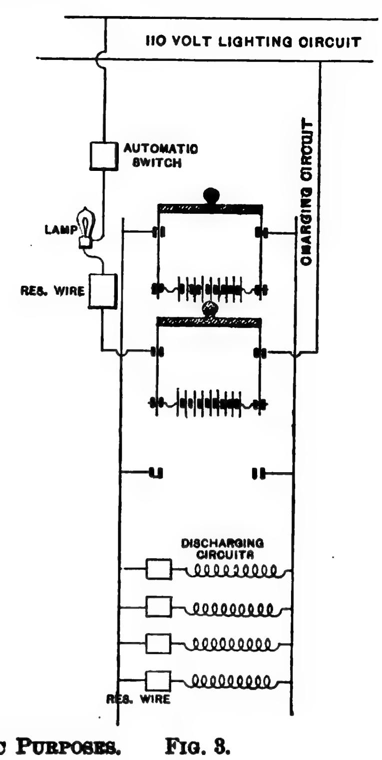


Fig. 1. Applications of Storage Batteries to Telegraphic Purposes. Fig. 3.

When a storage battery is to be used in light and power central and sub stations, for the purpose of removing from the generator curve the peaks and irregularities that exist in the load curve in order to reduce it to the form that ensures the most economical operation of the plant, a careful study of all the conditions peculiar to each individual case is necessary before it is possible to decide upon the battery equipment.

When, on the other hand, the battery is intended for work formerly done by primary cells and for similar applications, a little practical experience is all that is

needed in order to be able to determine at once the character of the outfit required. As, however, even in work of this class, considerable variety exists in the methods of using storage batteries, owing to different local conditions, a description of a few plants of this kind will be of interest to those who are about to adopt storage batteries for similar work.

The first example we wish to refer to is that of the Baltimore office of the Chesapeake & Potomac Telephone Co. The outfit here used consists of two portable four-volt batteries. When one battery is exhausted the other is put on the circuit and the first is carried by two men a distance of about three squares to a charging station. This system has been in use for over two years, doing the work formerly done by about 80 gravity cells and in a manner that has proved in every respect more satisfactory than the service obtained from the primary battery. With regard to this method of using storage batteries the only point we wish to draw attention to is, that on account of the inconvenient arrangement for charging the battery and the fact that a duplicate set had to be provided, put up in a comparatively expensive portable form, the conditions would have been favorable to a continuance of the use of the primary battery if any comparison of the relative merits of primary and storage batteries for this class of work were admissible.

In Fig 1. is shown a diagram of the arrangement

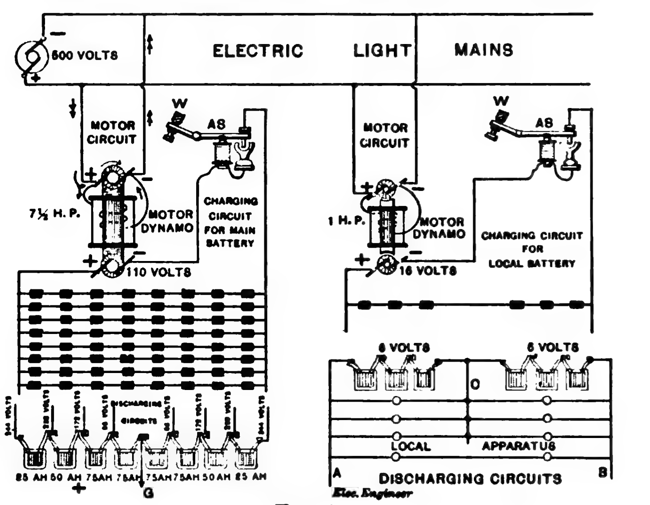


Fig. 2.

adopted for using storage batteries in the office of the Postal Telegraph Cable Co. at Baltimore, and in Fig. 2 is shown that in use in the Western Union office at Atlanta, Georgia. In the Baltimore office the storage battery takes the place of 4,000 gravity cells, while in the Atlanta office 8,000 cells are displaced. As the character of the work done and the local conditions are similar in both cases, while the methods of using the storage battery are different, a comparison of the arrangements used in the two plants may prove of some interest.

In both cases overhead lighting circuits are depended upon for power, and both make use of motor generators for the purpose of converting the current in the street mains to a voltage suitable for charging the batteries. Both also use a high and a low voltage generator. In other respects the arrangements are different. In the Western Union plant a complete duplicate set of batteries is provided, one to operate the lines while the other is charging, with suitable switches for changing the circuits alternately from one set of batteries to the other. In the Postal plant no duplicate parts are provided, and the battery is charged and used at the same time. In both cases it will be noticed that the voltage of the "high" voltage generator is not sufficient to charge the "long ends" of the "Quadruplex" battery in one series. In the Western Union plant, the "long" batteries are divided into sections, which are connected in parallel series while charging and are thrown back into direct series when discharging. In the Postal plant, the "long" batteries are charged in sections, as shown in the diagram. The increase of voltage in the battery that takes place when a section is getting charged is not sufficient to be noticed in the operation of the Morse instruments.

It will be observed that the types of motor generators used in the two offices are somewhat different.

In the Atlanta plant the motor and generator windings are superposed on the same armature and both are excited by the same field magnets. In the Baltimore plant the motor and the generators are separate machines, having their armature shafts joined together in the same line by means of insulated couplings. The former types of machines were at first for a time used in the Baltimore office but they had to be abandoned on account of the liability to damage from lightning, the electricity making its way to earth through the ground on the battery circuit by way of the double winding on the armature. When the batteries are disconnected from the telegraph lines while being charged, as is the case in the Atlanta plant, the liability to damage from this cause is not nearly so great, but in case trouble does not occur the repairs needed are generally more difficult to make on account of the more complicated construction of that type of machine.

Whether the feeling of greater security afforded by the use of the duplicate set of batteries is sufficient to offset the greater first cost and somewhat greater attention required, will probably remain a matter of opinion. That the risk of breakdown due to failure of the storage battery is so small as to seem scarcely worthy of being taken into consideration, can be judged from the fact that during the first summer that the Baltimore plant was in operation, and previous to making the change in the type of generator used, although an armature was burnt out by lightning on an average of about once in every two weeks, and on one occasion the lighting station supplying the power was completely destroyed by fire, not to mention many stoppages due to neglected bearings and brushes, and the fact that no current could be had on Sundays, there was not a moment's interruption of the battery current nor occasion to use the primary battery that was held ready to be switched on in case of an emergency. This fact we think goes far to prove that the storage battery is the most reliable part of the whole system.

With regard to the amount of attention required for a plant of this kind, it may be stated that in the Baltimore office not one cell or connection has been disturbed since the battery was first set up about two years and a half ago. Water has to be added occasionally to make up for the evaporation of the electrolyte. In cells now put up, evaporation is reduced to a minimum by covering the surface of the liquid by some solid substance, such as paraffine, poured on while hot. When first put in operation a daily record was kept of the state of charge of the battery as indicated by observations of the hydrometer and voltmeter readings of each section. The uniformity of the readings, however, rendered this operation monotonous, and it was soon abandoned as unnecessary. The color of the plates is now relied upon to indicate when a section needs charging, while the appearance of the electrolyte shows when the cells are fully charged.

Although both ends of a quadruplex battery are seldom used to the same extent, one or the other or both ends being used according to the amount of business, or the convenience of the operator, no inconvenience is experienced on this account. The charging current is usually turned on to a different section each morning and left on until it is fully charged. Previous to the introduction of the storage battery, it was often found necessary in bad

weather to throw out of operation "one side" of the quadruplex, owing to leakage of current on the lines. Since the storage battery has been in use there has been no trouble of this kind, the battery responding readily to the greater demand made upon it in wet weather without perceptible diminution of voltage.

The battery used in the Atlanta office is of the Chloride accumulator type, and that used in Baltimore is the Donaldson-Macrae type of pasted plate.

In Fig. 3 is shown a diagram of the storage battery outfit used in the City Hall, Philadelphia, to operate police telegraph circuits. A duplicate set of batteries is provided, one to be used while the other is being charged. The charging is done direct from a 110-volt lighting circuit with incandescent lamps for resistance to reduce the voltage.

This arrangement is the one generally used and best adapted for police, burglar and fire alarm systems. On account of the grounds generally existing on these circuits it is necessary to have a duplicate set of batteries in order to be able to charge direct from lighting or railway circuits by simply introducing resistance to cut down the voltage to the desired amount. The loss of current in such resistance is seldom sufficient to justify the use of a motor-generator.

In view of the present state of the art it is somewhat amusing to recall the prejudice that until very recently existed against storage batteries. Three years ago one of the companies making storage batteries designed a type of cell especially intended for telegraph work. After testing it in the factory, a man was sent out with a sample cell to solicit an opportunity of testing some of them on telegraph circuits. The superintendent of telegraphs of a railroad, the first person called upon, was asked if he would take a look at the battery, but before the wrapping paper could be removed from the sample, the superintendent had vanished into his private office. The local manager of the Western Union was next seen, but he thought "life too short to fool with storage batteries." Such was the general character of the reception met with. The representative of a storage battery company does not now, however, meet with nearly so many persons who "know all about storage batteries"; and although some are still found who doubt whether storage batteries are as well adapted as primary cells for the class of work above described, they can hardly be dignified by the name of skeptics. They are simply not informed, and can be relied upon to bring their ideas up to date when they find time to investigate.

As to whether in the very few cases where absolutely reliable power can be obtained all the year round dynamos may not prove as satisfactory as storage batteries for the operation of Morse instruments, there may be some grounds for doubt. An operator familiar with dynamos might not perhaps wish to change to storage batteries, while one accustomed to using storage batteries would certainly not wish to undertake the care of 20 or 30 dynamos. Although, as far as the operation of Morse instruments is concerned, the pulsating current from a dynamo does as well as the current from a battery except for a somewhat greater sparking at the contact points, the induction from such currents very seriously interferes with the operation of telephone circuits in the same neighborhood. This consideration alone ought to be sufficient to render a decision in favor of the use of storage batteries. With regard to the relative economy of the two systems this also appears to be in favor of storage batteries. If, as is now almost universally admitted, a saving can be effected by the use of storage batteries in central stations, running 24 hours in the day, and using large dynamos to furnish current of one or two voltages, it is certainly reasonable to conclude that a relatively much greater saving would result from the use of a storage system where the character of the work is such that it can only be done by a large number of small dynamos of different voltages.

LITERATURE.

Jahrbuch der Elektrochemie (Annual of Electrochemistry), 1894. Scientific Part by Dr. W. Nernst; Technical Part by Dr. W. Borchers. First Year. Halle, a. S., 1895. Wilhelm Knapp. 274 pp., 6½ x 9½ inches. Paper. Price, $2.50.

THOSE who have followed the rapid rise to industrial importance of electro-chemistry will hail with delight a work which proposes to give us, year by year, the gist of what has been accomplished by workers in the field of electro-chemistry. Outside of the electrotyping and plating, electro-chemical operations have had but a small place in the larger industries of nations, and it is only within comparatively recent time that they have begun to occupy an important position in refining of metals. Gradually, however, electro-chemistry is forcing itself into a position of the first rank, and refined electrolytic copper is now a powerful rival, even to the purest Lake copper. But it is not alone in the refining of metals that the newer electro-chemistry will find its application. The production of bleaching and disinfecting materials, already begun, is destined to reach proportions which are now scarcely dreamed of. It has already been demonstrated that bleach and alkali can be produced commercially at a far lower cost by electrolytic means, than by the usual purely chemical process, and the work begun in this direction has but hardly started.

In the work before us the authors, well known authorities in their chosen fields, have divided the subject under two general heads, namely, scientific, and applied electro-chemistry. In the former department, undertaken by Dr. Nernst, we find grouped together the various investigations which have been carried on during the year, including electrolytic dissociation, potential difference between solutions, and the potential difference between metals and solutions, as well as anomalous differences of potentials. Considerable attention is also devoted to electrolytic conductivity, the electrostatic field of the ions, and similar phenomena, and this part of the work is concluded with a description of electro-chemical measuring instruments, including chemical electric meters, among which we notice those of Waterhouse, Oettel, Anders and Kottgen.

The part devoted to applied electro-chemistry shows at a glance the wide field for operations inviting the experimenter, opening with a chapter on the latest forms of galvanic batteries, all of which are briefly but clearly described. The author then passes to accumulators, of the lead and the copper-zinc type, which are treated in a similar manner. Quite properly the author has included in this work a description of the latest methods of reducing metals by the heat of the electric current, applied in various ways, both by the arc direct and by the heat produced indirectly by electricity. It is true that not all the apparatus described has gone into commercial operation, but as the design is to give a record of all that has been done it deserves a place in the volume.

Of special interest is the chapter devoted to the description of the latest work in the obtaining of alkali and chlorine. We here find described a variety of apparatus, including the methods of Oettel, Haeusermann, Naschold, Hargreaves, Berg and Roberts. We also find several forms of apparatus in which the destruction of the electrode is sought to be overcome by the employment of liquid metals, and also apparatus without diaphragms, and a variety of information on organic and inorganic combinations carried out electrolytically. The work is brought to a close with a list of books and other publications on the subject issued during the year 1894, and an excellent index of authors and of subjects. We can heartily recommend this annual to those interested in this growing subject.

Elektrotechnisches Wörterbuch. (Electro-technical Dictionary.) English, French, German. By J. Sack, with addenda by A. Wilke. Leipsic, 1895. Oskar Leiner. 123 pp.; 5½ x 8½ inches. Paper. Price, $1.50.

FOREIGN terms and expressions are so frequently encountered nowadays in technical writings that a handy dictionary has become an indispensable vade mecum to the reader not thoroughly conversant with foreign languages. The ordinary technical translating dictionaries are lamentably deficient in electrical terms, and hence a special work devoted to this purpose will be most welcome. The one before us is very carefully got up, and a critical examination shows it to be singularly free from errors. The work is arranged in three parts, translating as follows: English to German; French to German; and German to English and French. By this arrangement the terms can be readily looked up by a reader conversant with any one of these three languages.

It is curious to note how rapidly the language of electricity is increasing. The author in his preface states that he believes the annual increase of expressions to amount to several dozen words, which emanate largely from English, and more particularly American electrical engineers, who, according to the author, coin them on the slightest provocation. Thus he cites the American term "booster" which he does not consider a legitimate expres-

sion, and hence has omitted from the dictionary, at least for the present. We also note as a curious fact that the French have recently adopted the word *trólet* for trolley and the author also suggests the adoption of the word *Trolle* in German to designate the same object.

TELEPHONY.

THE DELANY SYSTEM OF MACHINE TELEGRAPHY.

MR. P. B. DELANY'S ARGUMENTS AND CLAIMS.

According to official reports there are about a million miles of wire in this country used for carrying messages by telegraph and telephone.

The capital stock of the Western Union and Postal Telegraph Companies and the American Bell Telephone Company aggregates nearly two hundred million dollars.

A new Telephone Company just starting is reported to have a capital of three hundred and sixty millions. Ignoring hundreds of local companies lately sprung up, there is now, or soon will be, over five hundred million dollars stock represented in means of electrical communication.

The number of telegrams sent in the U. S. in a year is now about seventy-five million or about one and one-quarter for each inhabitant. The average tolls are 30 cents and the average cost 28 cents. The number of telephone messages sent is not known. About two million words of press reports are sent daily.

Hardly any one realizes how rapidly the telegraph and post office business has increased in this country. There are seven times as many telegrams sent now as there were twenty years ago.

There were nearly four and one-quarter billion letters sent through the mails last year or about 70 per capita. The total expense of the work was about seventy-five million dollars.

The present receipts of the New York Post Office alone are considerably greater than the receipts from the entire country forty years ago.

During the past ten years there has been an increase in the number of pieces of mail handled of 148 per cent.

Twenty years ago there was no telephone.

Means of communication have progressed from the post-boy, the packet-boat, and stage coach to the fast mail train going forty miles an hour, and the instantaneous telegraph and telephone.

Rapid telegraphy by machinery will carry the bulk of correspondence in the near future. The train service is entirely too slow, cumbersome, and expensive.

Why should a letter of say fifty words be handled by a dozen or more people, sorted, pigeon-holed, bagged and distributed, hauled in wagons and carried in bulk by train from New York to Chicago, occupying over twenty-five hours' time, when it can be punched on a strip of paper in two minutes, transmitted mechanically by telegraph in three seconds, type written in Chicago and dropped in the post office in three minutes more, or a total time of about five minutes, compared with twenty-five hours by train.

This can be done at an actual cost of five cents, but it can only be done by a system having these features, viz., copper wires of high conductivity, machine transmission, and electro-chemical reception.

It cannot be done by present telegraph systems or by telephone, the limit of which latter is about 40 words per minute including repetitions and delays, and as almost every one knows, no reliable record can be made of the message even at this slow speed.

Between New York and Philadelphia a single wire of 800 lbs. copper to the mile worked by the Delany System will carry three thousand words per minute, making a record as perfect as engraving and as plain as print and which can be type written much faster than from stenographic notes, and as it is impossible with this system to mistake a dot for a dash, or couple them together erroneously, there is no chance whatever for mistakes in translation.

To do this same amount of transmission, three thousand words per minute by the present hand system, would require 38 wires worked quadruplex or 152 circuits, at nearly 20 words per minute each, which every telegrapher must admit is too high an average for quadruplex circuits.

Special attention is invited to these two last paragraphs and contradiction is challenged from any telegraphic authority.

Hon. John Wanamaker, through his investigation of systems of telegraphy at home and abroad while Post-Master General, was made aware of the possibilities of machine telegraphy, although at that time the Delany automatic system was not perfected. In his report for the fiscal year ending June 30, 1891, he says:

"Since the introduction of the quadruplex twenty years ago, the Western Union Company has, I am told, made but one change or improvement in it's method of telegraphic transmission having for their object the greater speed or the transmission of a larger volume of traffic of a given wire. I refer to the Wheatstone Automatic, an English invention, which has been in successful use on the Government lines in that country for eight or ten years. On the other hand, England has not only adopted our quadruplex, but also the Delany Multiplex, another American invention.

* * * * * *

The Western Union Company, having control of the telegraph business, has no use for devices which cheapen and quicken the telegraph service and warrant a claim for reduction of rates. The public, not knowing what it misses, cannot become aroused to the defects in methods now in vogue."

* * * * * *

That Post-Master General Wanamaker appreciated the benefits which would inure to the entire people from low rates and that he foresees that the bulk of correspondence will be telegraphed, the following extracts from his report fully show:

"The rapid transmission of correspondence is a part of the business and proper duty of the Post-Office Department, and it does not fulfill its functions or perform its full duty until it operates the telegraph, the most rapid means of transmission of intelligence."

* * * * * *

"The one potent agency and the only one that remains beyond our reach is electricity. Its practical value has been known for half a century, but the Department stands in relation to it where it stood 50 years ago. The business of the entire world is to-day so dependent upon electricity that its withdrawal would seriously affect almost every interest that exists; yet the chief servant of all the people, the post-office, which by its equipment is able to make the largest and most beneficient use of it, is so limited in its authority that it can only adopt the slower methods."

* * * * * *

"I believe more earnestly than ever that the telegraph ought to be applied to the postal service so that the two great systems, like the railroad and postal service, may quicken and cheapen transmission of messages for the benefit of the unserved many."

* * * * * *

Telegraph Companies have argued against telegraphy by the government on these grounds:

First, that messages were already being transmitted as cheaply as or cheaper than the government could transmit them.

Second, that any interference by the government would be a great hardship to the telegraph owners, and an impairment of their vested rights, etc.

Of course every one at all close to the question knows very well that the telegraph companies are by interest bound to make an ostensible fight against government telegraphy, so that when it comes about they will be in a position to demand a large sum for their property. If they favored purchase by the government they could not pose as martyrs to the public weal. The telegraph interests are arranging matters for the future.

The history of the telegraph in this country is unique. So long as a portion of the traffic could be diverted to a new company, opposition lines were built, and as fast as new lines were built the Western Union Company felt compelled to buy them up, in order to prevent competition. Thus, about forty opposition lines of very inferior construction have been taken over, and have swelled the Western Union mileage to an abnormal degree.

By this policy the company became a possessor of wires, not a promoter of systems. So long as they had wires thrust upon them, sometimes in advance of the business requirements, they did not care to render them valueless by development of fast telegraphy. This policy of discouragement of all improvements of systems has cost the Western Union Company a great deal. They might have bought Bell's Telephone for a paltry sum twenty years ago. Five per cent. of its subsequent value would have paid for all the improvements in telegraphy ever offered to them. To-day the telephone is as great as the telegraph.

Without desiring to disparage the efforts of others that have made progressive steps in this branch of electrical science, it is necessary in pointing out the advantages claimed for the Delany system, to state some of the defects which have beset all the others, which defects will be acknowledged by all electricians and telegraphers competent to speak on the subject. These defects have been:

First. The Perforating Machine.—From Bain's crude and impracticable instrument through the gradual improvements by Siemens, Humaston, Phelps, Little, Edison, and others up to the very ingenious, but complicated perforator of Anderson, the preparation of messages for automatic transmission has been attended with much difficulty. Perforating machines have been complicated, easy of disarrangement, difficult to operate, and very expensive, some of them costing as high as $800 to make.

The Delany perforator has but three keys, and three moving parts. It cannot get out of order. It may be worked after a few days' practice, and it costs but $75. It can be worked at the rate of 25 words per minute.

Second. The Transmitter.—Heretofore all transmitting machines for fast automatic telegraphy have employed a contact finger, brush or wheel, pressing on top of the perforated strip and making electrical contact through the perforations with a revolving wheel underneath the tape. This form of transmitter has always been unreliable in operation, mainly on account of the face of the wheel becoming gummed with dust and oil from the tape, thus causing imperfect contact, which difficulty was aggravated by the lubricated connection rendered necessary by the revolving wheel.

In the Delany transmitter these defects are wholly obviated. The contacts are made by wire contact brushes *above and below*

the tape, pressing toward each other. When the paper intervenes the circuit is broken. When a perforation is drawn between the brushes of course the circuit is instantly and perfectly completed. The brushes are made up of six wires each, so that there are really six contacting points, which insures unfailing and uniform transmission. There are no revolving wheels, and the brushes are constantly cleaned by the edges of the paper between the perforations. A year's experimentation and actual working over long cables, requiring absolutely perfect contacts, has not developed a single failure with this form of transmitter. There is no loss of motion or time in making the contacts as is the case with all other automatic transmitters. The brushes are never separated more than the thickness of the tape, and the time consumed in coming together at each perforation is practically inappreciable.

Third.—Heretofore in automatic chemical telegraphy dots and *dashes* have been punched in the transmitting tape and sent over the line.

The line is more heavily charged by a dash than by a dot. It is well-known to electricians that when a line is charged for unequal periods the static *discharge* following each unequal signal is also unequal, that is to say: When a dash is sent there is a greater current discharge from it than when a dot is sent. Consequently, with high speeds on lines of any considerable length, the discharge following a dash is almost sufficient to obliterate a dot following immediately afterwards.

In the Delany system *no dashes are sent.* Nothing but dots, but owing to the currents employed, and to *a new form* of receiver, such of these dots as are meant for dashes are plainly designated as such on the receiving tape.

On the punched tape all dots representing dots are in one plane, and are sent from one pole of the transmitting battery, while all the dots representing dashes are in another plane and are sent from the opposite pole of the battery.

At the receiving end of the line all the dots are similarly in one (the centre) plane, while the dots representing dashes are *divided* and formed in *two* lines, one above, the other below the dot line, so that it is impossible to mistake a dot for a dash.

In this way the well-known effects of "tailing" or running together of signals is avoided on the receiving tape.

This important feature of the Delany system not only permits great increase of speed but renders translation of the characters by the copyist or typewriter much easier and more certain.

Over an ordinary iron wire, 350 pounds to the mile between New York and Philadelphia, which now yields 60 words per minute quadruplexed, it will carry 2,000 words per minute.

With a copper wire weighing 300 pounds per mile between the same cities, it will carry 3,000 words per minute.

It will carry 1,000 words per minute between New York and Chicago over a copper wire weighing 350 pounds to the mile.

The cost of a line of two copper wires, 350 pounds per mile each, constructed on poles in the best manner, everything included except rights of way, would be about $550 per mile, or

for 1,000 miles	$550,000	
Cost of apparatus, etc., at both cities, all ready for working	$ 25,000	
		$575,000

Operating Expenses.

Rents, light, fuel, per year	$30.000	
Labor 150 employees	90,000	
Superintendence	10,000	
Perforating and receiving tape	30,000	
Repairs, patrol, etc	20,000	
Battery, stationery, etc	10,000	
Postage for delivery at 2 cts. per message	57,600	
	$247,600	
Interest at 6 per cent	34,500	
		$282,100

Earning Capacity.

Two wires operated at an average speed of 500 words per minute each, including all delays.

Total words per day, 1,440,000; 50 words per message, 28,800 messages per day; at 15 cents each, $4,320 per day.

Total per year, 300 days	$1,296,000
Operating expenses	282,100
Balance	$1,014,000

It may be asked whether this large volume of correspondence could be secured. There can be but little doubt about it, as there are upwards of 40,000 letters carried between New York and Chicago daily, several thousand telegrams at the present rate of 40 cents for ten words, a large amount of telephone conversation at over a dollar a minute, and an immense amount of newspaper work.

There are probably several thousand special delivery letters exchanged between these two cities daily, costing ten cents extra postage to expedite their delivery *half an hour* after about 24 hours have been consumed in train transportation. It is but fair to assume that nearly all these latter would be telegraphed by the Delany system.

General Plan.

The general plan for a company to make an entirely new departure in telegraphy should, it is thought, be about as follows:

It should not compete for stock or exchange business requiring instantaneous transmission and delivery, but should seek the less urgent business of greater volume, and at rates which would secure at once a large share, and eventually the greater portion of the correspondence now conducted through the mails.

Instead of maintaining hundreds of branch offices involving great outlay, there should be but one central station, located close to the General Post Office in each city. Messages could be sent to these central stations from any part of the cities, or from points adjacent, through the mails, in the ordinary way. Each sender of a message would enclose the requisite tolls in stamps issued by the Company, and which would be on sale at drug stores and other places throughout the city. A uniform tariff, 50 words for 15 cents, and one cent for each additional five words, or fraction thereof, would be charged. A message placed in an envelope directed to the central office of the company and dropped in any post box within the city limits, would reach the telegraph office, on an average, within an hour. It would be transmitted and dropped in the General Post Office at the other end within ten minutes, and would be delivered by the postman within an hour thereafter.

Thus, letters would be collected, transmitted and delivered, on an average, within two hours, for 15 cents, as against about 30 hours at a cost of 2 cents, or 12 cents if an extra 10 cent stamp is used.

At present to send a letter from New York to Chicago and get a reply takes 3 days. Surely a large percentage of these letters would be telegraphed if a reply was certain to be in hand within three or four hours.

As the single telegraph station would be located in the centre of the business district in each city, special delivery by the Company's messengers could be made for 5 cents extra charge, thus reducing the time for a telegraph letter and reply to about an hour, which is much quicker than the average time necessary for the ordinary services at present.

In addition to the traffic originating in Chicago and New York and intended for delivery within the city limits, it is but reasonable to suppose that letters for towns and cities adjacent, or even far beyond would be sent by telegraph over the 1,000 miles intervening between the two distributing points. Letters from New York for Milwaukee, St. Louis, St. Paul, Minneapolis, Denver, San Francisco and other places could be mailed at Chicago, thus saving about 24 hours. And in like manner letters from Chicago for Philadelphia, Baltimore, Washington, Boston and other points in the east could be mailed from New York.

As a matter of course a system of this kind employing a minimum number of wires with maximum carrying capacity could be extended to all the large cities of the country, practically carrying the mails and securing a great portion of the patronage now enjoyed by the telegraph companies.

An outlay of say ten millions in lines operated by this system in the manner proposed would afford facilities for carrying as much traffic as is now handled by all the companies combined, with capital stock approximating 150 millions.

Should government telegraphy ever come about it must be by this or some other system equally as rapid, for by no other means could so great a volume of business be handled at low rates.

Telegraph properties as now constituted consist of poles loaded down with cheap wires, and operated manually, by systems necessarily slow. To provide facilities wires have been multiplied until the poles are overloaded. This aggregation of wires on each line of poles has seriously impaired the usefulness of each individual wire. That is to say, if five new wires be strung upon a line of poles previously carrying five, it must not be supposed that the telegraph company has doubled its capacity. The added strain on the poles, increased liability to interruption of a number of wires by the breaking of one, together with the various electrical complications introduced, impairs the efficiency of the entire ten to an extent which would be fairly represented by seven perfect working wires.

The telegraph of the future will comprise substantial poles, a few large copper wires, and rapid automatic systems capable of utilizing the full carrying value of the conductor.

It is estimated that it costs $4 per mile per wire per year, to keep the present lines in repair. A copper conductor costs no more to maintain than an iron one. On this basis two copper wires operated by the machine system with a capacity equal to 40 wires operated by hand, as at present, would cost $8,000 per year to maintain between New York and Chicago, as against $160,000 per year for the maintenance of the 40 hand worked wires.

In conclusion, the automatic system has the great advantage of secrecy; if desired, messages may be perforated by a clerk or private secretary or typewriter, and sent to the telegraph office where the tape is run through the transmitter. The tape may then be taken away by the sender of the message. At the receiv-

ing end the tape containing the message is delivered direct to the person for whom it is intended, for private translation. The telegraph clerk simply reads the name and address and encloses the tape in an envelope. In this way also the cost of correspondence to business firms and others preparing and translating their own messages would be greatly reduced.

THE TELEPHONE IN ENGLAND.[1]

BY G. L. ADDENBROOKE.

During the course of the writer's preparations for the review of Mr. Bennett's work on the telephone systems of the Continent which appeared a short time since in this journal,[2] some points were brought into prominence which did not appear to come within its scope, but which nevertheless appeared of importance. These were accordingly reserved, and a portion of them are now published, as they form an apt and fitting comment on the chairman's speech at the recent general meeting of the National Telephone Company.

Scattered through Mr. Bennett's book are the rates of wages paid in each country. It occurred to the writer to extract these in the form of a table. To these he has added the rates which are paid by the Telephone Company and Post Office in England. Mr. Bennett has himself kindly checked the table to see if it was a really fair statement to deduce from his figures. The English figures have also been seen by Mr. Preece at the Post Office, who expressed his general concurrence with them. That they represent fairly the National Company's wages the writer has also reason to know. It has been a little difficult to make a fair comparison because of dietary and other allowances given on the Continent and not in this country, but if anything, the comparison is in favor of England.

The table has been got out in the form of shillings per week, neglecting fractions to admit of ready comparison.

TABLE SHOWING WAGES PAID PER WEEK IN SHILLINGS.

Country.	Outdoor Operatives. Foremen.	Wiremen.	Laborers.	Switch-room Operatives.
Austria	28	20	15	8 to 10, to 14 in 3 years.
Belgium	32 to 40	14	11	8 to 16
Denmark	40	26	21	5.5, 4 hours, to 14.5, 6 hours.
Bavaria (Germany)	40	23	17	12, boys.
France, Paris	40*	30	..	12 to 20
France, Provinces	36	24	..	10 to 18
Holland	30 to 40	24	18	6 6 to 10
Norway & Sweden	27	20	15	11 to 19
Switzerland	30 to 36	22	15	15 when fully competent.
England, London	38 to 45	28 to 34	21	About 10 average.
England, Provinces	27 to 42	23 to 26	20 to 23	About 9 average.

* And allowance.

Besides its bearing on the telephone industry this table has a wider interest, because the wages in telephony approximate in all cases to the wages paid for line work in telegraphy in all the countries, and these wages again are about the same to those paid in the allied electrical industries. These wages are therefore some indication to electrical engineers of the relative scales current in the chief countries on the Continent. It is only fair to remark also that the writer has good reason to believe that, with the exception perhaps of Paris, house rent is cheaper all over the Continent than in England, and the price of commodities generally rather less. The foreign workman is, therefore, generally in rather a better position relatively to his English *confrère* than the figures show, while on the other hand there is, it is well known, a general idea that an Englishman gets over the ground rather quicker. When these matters are taken into account, it will be seen how closely the reward of labor, in this industry at any rate, approximates in this country. Belgium seems to form the most remarkable deviation.

Returning to telephony, the remarkable points about this table are that foreign wages for outdoor work approximate in many cases closely to English; while for switch-room operatives, who are mostly ladies, the wages paid abroad are, if anything, higher than our English rates. It is clear, therefore, that there is no argument from these items that English exchange subscription rates should be more than a slight percentage above foreign; since the labor in erecting lines is nearly as much abroad as in England, while the cost of operating—the real criterion, as it is a continual charge—is even less in England than on the Continent.

As regards the price of instruments and telephone material, they are pretty much the same everywhere, and, if anything, the advantage should lie with England.

1. *London Electrician.*
2. See also review in THE ELECTRICAL ENGINEER, July 17, 1895. (Vol. xx, No. 376, p. 56.)

The rates of annual subscription on the Continent and in England are as follows, the amounts being taken to the nearest shilling to make the table clearer and afford a readier means of comparison :—

——	Annual subscription.	Capital payment (if any).	Distance.
	Shillings.	£ s. d.	
Austria	83	4 3 4	500 metres (extra for extension)
Belgium—Antwerp	200	....	3 kilometres.
Brussels	200	....	
General State rate, (double wires)	...	....	....
Denmark—Copenhagen	166	....	....
Provinces	40 to 90	....	....
Germany	151	....	....
Holland—Amsterdam	195	....	....
Dordrecht	84	....	....
Breda	66	.. .	....
Hungary—Buda Pesth	250	....	....
Other towns	100	....	....
France—Paris	330	...	....
Lyons	240	....	....
Co-op. Societies	40	£8 to £10	....
Italy	160 to 56	...	....
Norway—Christiania	90	....	....
Provinces	66 to 28	....	....
Sweden—Companies	111	2 15 7	...
Government	89	2 15 7	....
Switzerland—First Year	96	*	....
Second Year	80		
Third Year	61		
United Kingdom—London	400	...	....
London, Five years	340	....	....
London, Private residents	240	....	....
Principal towns	200	....	¾ mile.
Few small centres	180	....	....

* 800 calls per annum, extra has to be paid on additional calls.

If, then, from what has been said above, a telephone line can be erected nearly as cheaply in England as on the Continent, if the materials for the line and the instruments at the subscribers' end and at the exchange are the same price, and if the line, after it is erected, can be operated quite as cheaply in England as on the Continent, it is clear that there must be some other reasons why a satisfactory telephone service can be provided at so much cheaper rates in many cases on the Continent than the National Company allege is possible in England.

THE NATIONAL LONG DISTANCE TELEPHONE CO. OF KANSAS.

A number of the business men of Topeka, Kan., who are now interested in the telephone system which is in competition with the Bell Company in that city are perfecting plans whereby a new company will be organized in Topeka with a capital stock of $200,000 to be known as the National Long Distance Telephone Company. The capital stock of the company will be divided among a number of Kansas towns. Those which are just now the most deeply interested are Holton, Horton, Atchison, and the principal towns in that section of the state which have been making an effort to secure telephones. Many of the cities in northern Kansas have recently chartered companies for the construction of telephones but the plans have been changed and now the one big company will be organized, local and long distance lines will be constructed and the cities will secure the benefits of a toll system which it is asserted will be operated much more cheaply than that of the Bell Company as the charge for using the long distance lines will be placed at 25 cents instead of 50 cents.

Simon Greenspan, A. K. Rodgers and other members of the Topeka Telephone and Electrical Company, which has succeeded the Harrison Company in that city, are backing the new enterprise. The plans are now in such a shape that the men who are pushing the matter are confident that the work will be consummated shortly. In fact, one of the members of the new company states that work would begin at once to build the first line to Holton. The line to Holton will be pushed to completion, extended to Horton and other towns along the Rock Island and on through the portion of Kansas, north and east of Topeka until the system has been made complete. Manhattan is figuring on joining the new company and prominent citizens in many of the central Kansas towns are desirous of gaining admission to the new corporation with the intention of competing with the Bell Telephone Company.

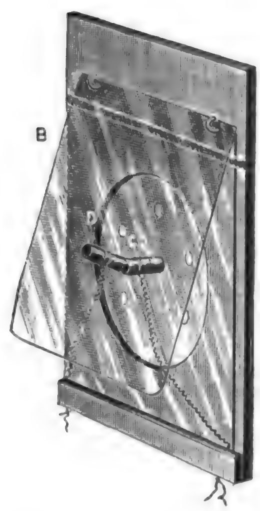
WILMINGTON, N. C., like Winston-Salem, is to have a competing telephone company. The aldermen of that city have just granted the Inter-State a franchise to establish and operate a plant there.

BLUE EARTH CITY, MINN.—The Blue Earth Valley Telephone Company, a recently incorporated company, have been granted a permit by the city council to erect poles in this city, and to provide for a long-distance service as well as local.

THE HOGAN DUPLEX COMPENSATING TELEPHONE.

THE accompanying illustration represents the Hogan "duplex compensating" telephone transmitter, recently brought out by the Hogan National Telephone Co., of Chicago, and which embodies a number of novel features. As will be seen, the instrument consists of a very thin sensitive plate of mica, A, through which a carbon pencil electrode C is fitted. This plate is made so sensitive as to be actuated by the lowest whisper, and is perforated, as shown, so as to allow a small percentage of the force of the sound waves to pass through this plate and strike plate B which is also of mica, in which is fitted a second carbon electrode D which by gravity is made to press against the electrode of the primary plate.

When one speaks in a low tone or whisper, the primary disc is actuated and corresponding undulations are produced in the current. If the instrument is spoken to in a loud tone, then a small percentage of the sound waves pass through the perforations of the primary disc and strike the secondary disc, which actuates that in harmony with the primary, and relieves the transmitter of any abrupt or jarring sound, that would naturally be the consequence of a transmitter adjusted to extreme low tones, without such a compensating plate.



THE HOGAN TELEPHONE.

Thus it is claimed that the instrument is adapted for short line as well as for long distance work, and since gravity alone is employed to keep the electrodes in contact the instrument maintains a constant adjustment.

THE GOVERNMENT TELEPHONE SUIT.

A special dispatch from Washington of August 28 says: The law officers of the Government have under consideration the question how further to proceed with the case against the Bell Telephone Company for the repeal of the Berliner patent. As the case now stands, the bill of the Government has been dismissed by the Court of Appeals for the First Circuit, and under that judgment the Bell Company has begun proceedings against several of the corporations which entered the telephone field after the expiration of the Bell patent, in 1893. The validity of the Berliner patent is essential to the further control of the telephone business by the Bell company, and the present situation is of additional interest, from a legal or judicial point of view, because the case involves a consideration of the act of 1891, establishing circuit courts of appeal.

By the terms of the act creating circuit courts of appeal the judgments of those courts are final in all cases arising under the patent laws, except where the Judges certify a case to the Supreme Court, or where the Supreme Court directs the case to be brought before it for review on a writ of certiorari. The telephone company is evidently inclined to accept the decree of the Court of Appeals as final, and is proceeding to enforce its claims under the patent. But the Government representatives are by no means disposed to let the case rest here. They say that a case involving the question whether or not the United States has the right to sue for cancellation of a patent is vastly different from a controversy between two private parties over a patent right, and that upon that point an appeal will lie to the Supreme Court from the judgment of the Court of Appeals. And even if that ground should fail them, they can sue for a review of the case on a writ of certiorari, as provided in the law itself. Which method of procedure will be followed has not yet been finally settled, but it is asserted that the case will not be permitted to rest in its present condition.

USE OF THE TELEPHONE WIRES FOR NEWS PURPOSES.

The Long Distance Telephone people did an immense business here during the convention hours Wednesday. It was the first time the Long Distance Telephone has figured in a convention in this city, and many newspaper men outside of Cincinnati, Chicago, and Cleveland, depended solely on the Long Distance for doing their work. Every evening paper in the state, who had a representative here telephoned the news of the convention Wednesday in time for publication that evening.

Manager W. A. Vail, of N. Y., was in charge with a corps of attendants consisting of C. A. Hunter, Cincinnati; G. E. Calhoun, Indianapolis; F. A. Pearl, Cincinnati; and C. Brooks and E. L. Cook, Chicago. Three booths were placed in the rear of the stage, and were kept in constant use, and two each in the Arcade and Lagonda house. Major Hoover, of the local exchange, in charge of the Long Distance business here, said that everything worked in perfect order. The lines and connections were in perfect shape, and the company was much pleased with the business done here. Mr. Vail and his assistants left for their respective homes Thursday evening. Extra booths will be left in the Arcade until after the meeting of the editors of Ohio, who come here in a body to call on General Bushnell, on the 27th inst.—*Springfield, O., Republic-Times.*

TELEPHONE NOTES.

PRINCETON, N. J., is establishing a local telephone service.

DEERFIELD, MASS., is soon to have telephone connection.

SULLIGENT, ALA.—A company is being formed to build a telephone line between Sulligent and Vernon.

BEREA, KY.—Rawlings and Fish have formed the Berea, Kingston & Richmond Telephone Co. to construct telephone lines.

FORT WAYNE, IND.—Mr. C. S. Bash has presented a petition for a franchise for the Fort Wayne telephone company.

SAN FRANCISCO, CAL.—The People's Mutual Telephone Company will be ready for business July 1, 1896.

PERRINTON, MICH.—The Maple Rapids Telephone Co. is building a line from Perrinton to Ithaca by way of Pompeii.

GRENADA, MISS.—B. L. Roberts, Emile Levy and H. W. Latimer have incorporated the Grenada Telephone & Telegraph Co. to construct lines. The capital stock is $250,000.

SAN JOSE, CAL.—The City Council has granted a franchise to the California Telephone and Construction Company. The franchise was sold for $50, and is to run for twenty-five years.

MELROSE, MASS.—At a special meeting of the selectmen permission was granted the Century Telephone Company to erect seven poles within the limits of the town.

GARRISON, COL.—The telephone line which has been under construction between here and Duncan for several months now is about completed.

TOLEDO, O.—The Central Telephone company have completed arrangements to build a $75,000 building. The site has not yet been made known.

PORT HURON, MICH.—An effort is being made by the local management to sell the Harrison Telephone plant to local capitalists.

LEADVILLE, COL.—The Colorado Telephone company is building a line from Leadville to Aspen over Independence pass, as rapidly as the task can be accomplished.

TOPEKA, KAS.—The McPherson Telephone company has been incorporated. The capital stock is $5,000 and the directors are as follows: J. E. Wright, J. R. Wright, J. G. Maxwell, L. M. Waitt and H. G. Smith.

WINONA, MINN.—Winona and Eau Claire, Wis., are soon to have telephonic connection, and as Eau Claire and Philips are already connected, service will be had between Winona, Philips and all the intervening towns. A line is also soon to be built between Winona and Arcadia, Wis.

NEWARK, N. J.—The Newark Telephone Company has filed articles of incorporation in the County Clerk's office. The company will do a general telephonic business in that city, Essex County, and Hudson County. It has a capital stock of $800,000, and there is $100,000 to begin active business.

HALIFAX, N. S.—A despatch from Charlottetown states that E. Franklin Clements, of the Standard Telephone Company, of New York, is at present trying to obtain consent of the Prince Edward Island Government to construct a trans-continental telephone system in that province. It is intended landing the cable at Cape Traverse. Clements is also arranging for the establishment of an electric street railway in the city of Charlottetown, to be built by American capital.

WAYCROSS, N. Y., is to have a telephone exchange.

OTTAWA, ILL.—The Bell Telephone Company has secured a controlling interest in the Dundas Telephone Company.

WAUSAU, WIS.—The Wausau Telephone Company expects to be ready for business about October 1.

BONHAM, TEX.—There has been chartered the Texas Telephone Company of Bonham.

ROSCOE, N. Y.—At the meeting of the proposed stockholders of the new telephone line from Roscoe to Lew Beach, the required amount, $1,500, was raised.

HOULTON, ME.—Mr. J. K. Butler, Supt. of the Eastern Division of the White Mountain Telephone Co. is arranging for a new telephone line between Houlton and Patten.

RUSSELL, ONT.—The Bell Telephone Company has begun to build the line from here to the main line leading from Ottawa to Montreal.

ALLENSVILLE, TENN.—The Cumberland Telephone and Telegraph Company is now engaged in extending the lines to Allensville and other points beyond Guthrie.

PENDLETON, ORE.—It is now expected that the line of the Blue Mountain Telephone and Telegraph Company will be erected and in full working order to Canyon City by November 1.

SUGAR GROVE, N. Y.—A telephone line connecting this place with Youngsville and intermediate points has lately been completed.

DOLGEVILLE, N. Y.—The Dolgeville Telephone Company will this year extend its line north, connecting with Salisbury, Salisbury Center and Stratford.

LISBON, N. D.—A telephone line is to be built from Fargo to this place connecting with the Fargo and Grand Forks circuit. Forty miles of line west of Tower City is completed.

REDLANDS, CAL.—The new apparatus for the telephone exchange has arrived and will probably be put in immediately, and Redlands will then have an up to date exchange.

CLEBURNE, TEX., will have a city telephone exchange put in by the National Telephone Company. Residences are to be charged $1.50 and business $3 per month.

HATBORO, PA.—William R. Dougherty is pushing the erection of the new Bell Telephone building, on West Chelten avenue, which will cost about $7,500.

DANVILLE, KY.—Mr. Eddy has secured twenty more telephones and expects to have a number of new subscribers supplied at once. He is also preparing to put in a new switch board.

VERNON, ALA.—The construction crew of the Courier Telephone Company, at Vernon, have commenced the erection of a line from Vernon to Fayette.

SAUGATUCK, MICH.—A new telephone company, to be known as the Saugatuck & Ganges Telephone Company, has been organized and will run a line from Saugatuck to Ganges via Douglass.

ALBANY, N. Y.—The board of aldermen, by unanimous vote, has granted a charter to the Home Standard Telephone company. The work of constructing the lines of the company will be commenced without delay.

SPARTA, WIS.—The City Council have voted the right to J. P. Rice and H. M. Sowle to build a telephone line through the streets of Sparta. It is understood that J. P. Rice of this city and H. M. Sowle of Tomah will build a toll line from Sparta to Tomah.

LANSDOWNE, PA.—The citizens of Lansdowne and vicinity are about to start an opposition to the regular company. They propose to put telephones into stores at $2.50 per month each and in private residences for $1.50 per month.

HUNTINGTON, W. VA.—The Huntington Mutual Telephone Company will very soon be in operation. The Old Dominion Electrical Construction Company, which is to put up the wires, has a large force of men at work.

BUENA VISTA, PA.—The Bedford County Telephone Company will extend its line from New Buena Vista to New Baltimore, the Town Council of the latter place having granted a permit for the erection of the necessary poles in the borough limits.

SIOUX CITY, IA.—The war on the Bell Telephone company here has begun in earnest. H. O. Woodruff, manager of the Sioux City Electrical Supply company, is disconnecting telephones of the Bell system wherever he secures permission.

ST. JOSEPH, MO.—Work on the new telephone line here has been stopped. The petition of a majority of the stockholders of the Citizens' Telephone Company for the appointment of a receiver and the issuance of a temporary injunction restraining Louis L. Strong from disposing of the company's bonds has been granted.

ABINGTON, MASS.—The Abington and Rockland Street Railway Company is at work on a new telephone system of its own. The company is building a line in connection with its own system of wires, and little sentry boxes are placed at intervals all along the road to South Weymouth.

MARSHALL, MO.—A new telephone line has just been completed to Slater from this city. It will be continued to Arrow Rock soon. Marshall will then have telephone communication with Fairville, Miami and Malta Bend, and perhaps with Sweet Springs later on.

RED HOOK, N. Y.—The Red Hook Telephone Co. have their line completed to Barrytown and Annandale. A connection will be made at Red Hook with the Hudson River Telephone Company, and at Barrytown with the Western Union Telegraph Company.

CLARKSVILLE, N. Y.—A meeting of the Clarksville and Feura Bush Telephone company has been held here. A large number of new members were added, and it was decided to at once build a line from this place to New Salem and Voorheesville and thence to New Scotland.

MANNINGTON, W. VA.—At a meeting of the board of directors of the Fairmont and Mannington Telephone Company it was decided to begin immediately the construction of a telephone exchange in Mannington. This company is already operating lines to several nearby towns in this county.

OAKLAND, CAL.—A bid for a telephone franchise has been received from the Commercial Telephone Company of Alameda County offering $50 for the franchise and half of one per cent. of the gross receipts. The bid was referred to the Ordinance and Judiciary Committee.

LANSING, MICH.—Jacob Stahl has contracted for $14,000 worth of telephone instruments from the Western Telephone Construction Company, of Chicago. Mr. Stahl, who is treasurer of the new Lansing telephone exchange, expects that the new exchange will be in working order October 1.

ATLANTIC CITY, N. J.—The Telephone Company of South Jersey, which is seeking a franchise here, is the same company which has been given franchises in Camden and also in Cape May. The company wants to erect poles and string wires for telephone, telegraph and burglar alarm systems.

CARBONDALE, PA.—A telephone system has been established here and the title of the Carbondale Telephone company adopted. The officers elected for the purposes of incorporation were: President, A. P. Trautwein; treasurer, Edward Clarkson; secretary, G. P. Rogers.

BUTTE, MONT.—One of the heaviest contracts yet undertaken by the Rocky Mountain Bell Telephone Company has been closed and the construction of an independent telephone line between the Montana cities of Butte and Great Falls will be commenced by the telephone company, and the work pushed to an immediate completion.

INDIANAPOLIS, IND.—The city council has passed a sweeping ordinance repealing all telegraph and telephone franchises within the business district of the city, including territory a mile square, and ordering that all telephone and telegraph wires be removed within a reasonable time. This is a determined stand by the council looking to the placing of all wires underground.

MEMPHIS, TENN.—A contract with the Memphis Telephone Company has been agreed upon. The contract states that the Memphis Telephone Company has agreed with the American Telephone Construction Company for the erection of a plant and exchange in Memphis, using the American telephone and Hunnings dust transmitter.

CHESTER, PA.—An ordinance has been introduced which provides for the establishing of a new telegraph and telephone company to be known as the Chester & Philadelphia Telephone and Telegraph Company, composed of Philadelphia capitalists. The president is Charles A. Furbush; vice-president, Daniel McCormick; secretary and treasurer, John J. McCloskey.

PATERSON, N. J.—Mayor Braun has signed the ordinance giving the New-York and New-Jersey Telephone Company power to lay conduits and subways for its wires in the streets. With $1,000 in taxes, $1,500 in telephone rentals saved by the stipulation of free service for municipal buildings, and at least $500 franchise fee, the city will, it is claimed, gain $3,000 annually by the new arrangement.

SUMNER, IA.—At the annual meeting of the stockholders of the Western Electric Telephone company, held in the company's office, J. F. Cass, Chas. Webster, Stitzel X. Way, Thomas A. Way and T. A. Potter were elected directors for the coming year. J. F. Cass was elected president, Chas. Webster vice-president T. A. Potter secretary, Thos. A. Way treasurer and general manager, J. G. Graham, superintendent and George S. Barr assistant secretary.

LETTERS TO THE EDITOR.

THE EXPRESS vs. THE MULTIPLE TELEPHONE EXCHANGE BOARD.

I have read the description in the ENGINEER of the new Express telephone switch board, and I cannot, for the life of me, see that it is an improvement on the multiple board.

We used, years ago, various forms of connecting tables, on to which we threw the caller, and he was there connected with the desired number. When finished, he was disconnected by a "clearing out drop" signal. For some time, one was used in the Milwaukee Exchange, invented by Harry C. Haskins. That system took two operators to make a connection. It was followed by the multiple board. That uses but one operator.

Brother Sabin's board requires three operators—four glow lamps—four relays—four spring jacks and plugs and a main battery to call with! Whew!! How would all this apparatus work in an exchange of 3,000 subscribers?

Better than this is the old board, where the operator made a ticket, the boy trotted down the board to the desired number, the operator there put the subscriber wanted on the trunk line mentioned in the ticket, and the connection was made. The only uncertain link in this chain, was the uncertainty of the boy, who frequently gave the ticket to the wrong operator and caused delay.

If, as stated, errors occur with the multiple board, where one operator makes the connection, what would be the result with this new system, with such a multiplicity of operators, relays, lamps and plugs?

C. H. HASKINS.

BUFFALO, N. Y., Aug. 24, 1895.

WAS IT AN INVENTION OF THE LIGHTNING REPORTER?

Referring to your article in the issue of Aug. 7, "Can Lightning Run Trolley Cars?", THE ELECTRICAL ENGINEER does not seem to have taken the story seriously but some of your readers evidently have done so.

In preparing a recent article on "Lightning Protection" for the New York Sunday *World* I had occasion to investigate some wondrous lightning displays said to have occurred in Harlem and other places, and what did I find? In one case lightning had knocked a chimney down and dispersed harmlessly upon the tin roof. In another case lightning came through a motor car, and broke up a fuse block. Two or three other cases that I investigated in Brooklyn were similar.

In the first case the lightning reporter described balls of fire as floating around through the flats, circulating round a gas stove, taking out a window, sash and all, and finally hitting the sidewalk and exploding with force enough to break all the windows in the block. In the second case a big ball of lightning came down through a tree, rolled along the tracks as if in doubt whether to take the ground or not until it met the motor car which seemed to excite a violent antagonism and which it punished by tearing a hole six or eight inches square in the controller box, and finally exploding under the car like a ton of dynamite, scaring all the passengers out of a year's growth. The cases in Brooklyn proved to be very similar. In the Sunday *Sun* (N. Y.) of Aug. 25th on page 7 is an article headed "Weird Jersey Lightning" which seems to be written by the same man, as does also the Norwich story already referred to. The lightning reporter and the sea serpent reporter seem to be engaged in an inventive intellectual contest this year with the lightning reporter considerably ahead at present writing.

A. E. DOBBS.

BROOKLYN, N. Y., Aug. 26, 1895.

"VERY GOOD."

MR. C. DOUTRE, the electrical engineer of the Ontario Navigation Co., Montreal, Canada, writes us: "The Data Sheets you are at present issuing are very good; they save a lot of time and labor."

"NEATNESS AND EXCELLENCE."

Mr. Harry Linwood Tyler writes us from his laboratory at Corning, N. Y.:—"I herewith enclose check for the renewal of my subscription. You are to be congratulated upon the neatness of make-up and excellence of matter embodied in your valuable publication."

"MUCH PLEASED."

Mr. R. J. Feather, of Milnrow, Lanc., England writes us: "Have been much pleased with your paper lately; think your Data Sheets are O. K., but would like to see them with greater regularity. I have enjoyed reading your paper * * and find it, to my mind, superior to all."

MISCELLANEOUS.

MELTING IRON BY ELECTRICITY.

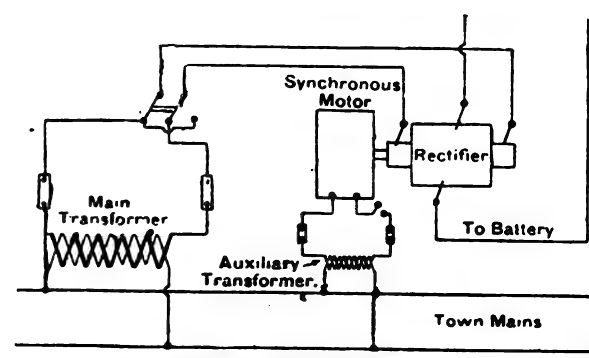
Gustaf DeLaval.

MR. GUSTAF DELAVAL, the inventor of the rotary steam engine which bears his name, is reported to have discovered a method of smelting iron directly from its ores by the aid of the electric current. Large iron works have been purchased in the provinces of Norrland and Wermland, in northern Sweden, the two great iron districts of the north, together with immense water privileges and vast deposits of peat to be used as fuel. If this process should prove commercially practicable, its influence on the iron industry can hardly be overestimated.

CHARGING ACCUMULATORS BY ALTERNATING CURRENTS.

An account is given in a recent number of the *Zeitschrift für Electrochemie* of a method employed by Herr C. Pollak for charging accumulators by means of rectified alternating currents.

The requisite apparatus for converting an alternating current of high voltage into a uni-directional current of low voltage consists of a main step-down transformer and a small auxiliary transformer, which drives a synchronous motor, having a commutator on a prolongation of its spindle, to which current is led and from which it is taken, after rectification, by appropriate brushes. The whole arrangement is clearly shown in the accompanying figure.



POLLAK'S ARRANGEMENT FOR CHARGING STORAGE BATTERIES FROM ALTERNATING CURRENT CIRCUITS.

By adjusting the set of the brushes the flow of current to the accumulators can be stopped at such part of each alternation as to avoid reversal.

At the Pollak Works at Frankfort the town supply of current at a pressure of 3,000 volts is transformed down to 65 volts and rectified as described above, the resulting uni-directional current serving for general electrolytic purposes as well as for driving ordinary direct-current motors. An efficiency of 96 per cent. is claimed for the rectifier, 2 per cent. loss being encountered in driving the small synchronous motor, and 2 per cent. in contact resistance.

ACTION OF THE SOIL ON IRON POLES, PIPES AND CEDAR POLES.

The *Annual* of the Engineering Society of the University of Michigan, gives some interesting information relative to the rusting of iron poles and the rotting of wooden ones. Experiments with ordinary 4-inch gas pipe used as trolley poles, and set in concrete up to the surface of the ground, without other coating, developed that they would become corroded through at about 10 inches below the surface in about three years, forming a black deposit. The life of white cedar poles in the clay soil of Detroit is said to be about 18 years, without protection or treatment of the butts. Norway pine poles have lasted in the same soil about 30 years, but were badly rotted at the surface line. They, however, rot very soon in a sandy soil. The more pitchy ones decay first. Winter cut poles and those cut in summer with the sapwood removed are more lasting than those containing green sapwood. It is reported that steam piping, covered with a nonconductor, and maintained at a temperature from 250° to 300° Fahrenheit, though buried in the ground, will not corrode, while a hot water return at 212° Fahrenheit, similarly covered and buried, would corrode from the outside by rusting.

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CONTENTS.

WHAT THEY WANT IS LIGHT.

THE past five years have not been marked by any radical changes in the methods of electric light distribution, and this condition of affairs has acted beneficially in so far as it has given more time and opportunity for bringing the present apparatus up to the highest state of efficiency. Nevertheless certain tendencies have begun to manifest themselves, which bid fair to have some influence on the future of incandescent lighting. We refer more particularly to the increasing use of the 25-candle lamp in place of the original standard 16-candle lamp. In order to appreciate fully the causes for this increase in candle-power now demanded, we must go back to the time when the commercial incandescent lamp made its appearance. At that time "20-candle" was the standard for gas illumination, and even that figure was reached in but comparatively few localities. When Mr. Edison adopted the 16-candle standard for his lamp he took what was probably a very good average of the illumination given out by 5-foot gas burners, the country over. The last fifteen years, however, have witnessed great improvements in gas manufacture, and whereas 20-candle gas was once a comparatively rare commodity, the larger cities of this country now average well up to 25-candle gas. Light consumers have not been slow to observe this fact, and it behooves the central station manager who has an eye to the future to be ready to meet the new condition of affairs. It will not do for the electric light man to argue that with a given number of 16-candle power incandescent lamps properly distributed the same illuminating effect can be obtained as with the smaller number of 25-candle power gas burners. He ought to be prepared to give his customer a unit of light at least equal to the prevailing standard gas unit. This view of the case is, we have reason to believe, beginning to gain ground, and added to it is the growing tendency to use high economy lamps. That the preachings of the lamp manufacturers have not been in vain is shown by the fact that the time-honored 600 hours of life is not nearly so often insisted on as formerly. Indeed, the specific requirement now demanded in not a few instances is a lamp that will maintain its candle power, at high economy, for from 300 to 400 hours.

We must not, of course, lose sight of the fact that the greatly reduced price of incandescent lamps has enabled the lamp consumer to carry out his ideas in this direction and to give his lamps a short and merry life in preference to the former lingering death. The introduction of 25 candle power lamps will doubtless be a gradual one as it must naturally be accompanied by a corresponding change in the fittings, cut-outs, wiring, etc., if applied to existing installations. But new work will probably be designed *ab initio* to conform to the coming order of things. In contrast to the demand for brightness and high illuminating power in lamps in this country, is the conservative European practice of employing 10 c. p. lamps as the standard. We are not aware that the number of lamps to light a given space abroad is much if at all greater owing to the lower illuminating power of the lamps employed, but must assume that Europeans are not given to liberality in lighting any more than in other items of daily expense. There is also some reason for believing that the satisfaction given abroad by the 10 c. p. lamp is due to the fact that the lamps are kept well up to candle power, a condition which has not invariably obtained in our own country.

THE DEADLY SHADE TREE.

One's feelings of indignation are sometimes aroused to see beautiful old shade trees mutilated or chopped down to make way for electric light poles, or trolley circuits, or even for houses; but there does appear to be also another side to the question, according to which the shade tree is often both pernicious and deadly. In fact, the contention might be urged that the trees are distinctly foes to health in many cases; at least abundant experience in Brooklyn, Cleveland, &c., points that way. But Mr. Alex. Dow, the electrician of the Detroit municipal lighting commission, now complains of the shade trees in that city as a decided nuisance. They are planted much too thickly, and when grown are left uncared for, so that their stems are stubby and their foliage is a clumpy sponge. They not only shut out the electric light but God's own sunshine. It is difficult to get wires or lampposts under them, but the illumination from towers cannot penetrate downward through their black masses of summer foliage, while in winter their bare arms are constantly breaking and falling upon the streets, the houses and the circuits. To this it might be added that they harbor noisy sparrows and hairy caterpillars that are always dropping down one's back. Even the glorious avenue of elms and chestnuts in East-hampton, Long Island, the pride of every artist, keeps the broad road wet and muddy long after the surrounding country has dried up, and gives a damp, clammy feeling to the atmosphere. We agree with Mr. Dow that the shade trees need regulating more than the poles and wires do.

SENDING THE MAILS BY TELEGRAPH.

We gave some interesting figures last week relative to the rapid growth of telephony and the fact that the long distance service has become a formidable competitor with the telegraph for some of the most profitable business. Indeed, it was shown that taking the two industries broadly, the telephone is ten times as often used as the telegraph, and that while the telegraph does not increase appreciably in the ratios of its use by the public, the telephone habit is gaining ground in a most remarkable manner. To-day, the population of the United States does not average annually much more than one telegram per head, whereas the telephone average is already ten messages per year, per head. When we realize that already in large cities, the ordinary subscriber uses his telephone ten times a day, and that only now have the suburban and rural portions of the community begun to enjoy the enormous advantages of the telephone, it will be seen that the telephone in frequency of use bids fair to leave the telegraph so far in the rear, that comparison will become ridiculous. Moreover, we record this week the use of the long distance telephone wholesale for convention news purposes, thus sapping the vitals of the telegraphic news systems of the Associated and United Press.

But there are those who contend that the telegraph has not yet been made to yield its full measure of usefulness, and chief among these experts to-day is the veteran telegrapher and inventor, Mr. P. B. Delany, who now proposes that the mails shall hereafter be sent by telegraph instead of by train and star route. With his permission, we print this week his pithy and striking argument on the subject. We recommend a careful perusal of his ingenious plan for expediting the mails. There can be no denying that Mr. Delany's views are sound in the main, and that to come up to the needs of the present hour, the telegraph demands distinct improvement or remodeling. The blue ten cent special delivery stamp on a "rush" letter is at once a condemnation of the slowness of the mail system and a confession that the telegraph has not yet been carried to the point where it can profitably intercept for itself the 12 cents total mail postage. But as Mr. Delany ventures to predict, two good copper wires fed with mail matter, on his plan, might be made to carry 28,800 messages of 50 words each per day between New York and Chicago, with a remarkable margin of profit and with an immense acceleration in the transaction of business. There appear to be upwards of 40,000 letters carried daily between the two cities, so that Mr. Delany counts on capturing a large proportion of that correspondence. How far his surmise is correct we will not undertake to say, but it seems to us that there would be an offset in the fact that many telegrams now exchanged at high rates would at once come within his reduced scale and thus lessen the existing telegraph income.

Mr. Delany's method of transmission is based radically upon the supercession of the dash by a system of double dots combined with the familiar single dots. He says that a single copper wire of only 300 pounds to the mile thus machine-worked between New York and Philadelphia will carry 3,000 words per minute, whereas by the present hand system, 38 wires must be worked quadruplex, or 152 circuits, at about 20 words per minute. If true, this is decidedly interesting, and if true, we do not see how an intelligent telegraph manager, beset by the telephone, can resist its appeal to his spirit and his desire for profit. It is noteworthy that Mr. Delany's scheme embraces the transcription of the tape at each end by the typewriter and the delivery by mail; but why could not the letters then be telephoned to everybody who has an instrument in his house or office? It would be a further economy of time and cost.

COPPER SHEATHING FOR SUBMARINE LIGHTING CABLES.

In commenting on the employment of copper wire armor employed in cables recently installed for conveying current to the electric buoys in New York Harbor, our excellent contemporary, the London *Electrical Review*, remarks that it does not quite see the advantage of copper, for the durability of copper in sea water is questionable, owing to the formation of the oxychloride which peels off. Our contemporary has evidently not weighed other factors involved in this unique installation. Without taking into account the relative life, under sea water, of copper and iron,—regarding which, by the way, we do not agree with our contemporary,—the question of practicability entered largely into the problem. It will be recalled that the current is alternating and is led to transformers placed on each buoy. Experiments at the Columbian Exhibition in 1893 had shown the enormous drop in the conductor with an iron armored cable, due to impedance produced by the surrounding iron sheath. It became a question therefore of a two-conductor iron armored cable, or to find some other method of protecting the insulated conductor. As two insulated conductors were not necessary, hard drawn copper wire was selected as the armor. This has the advantage not only of obviating all impedance but also of offering a low resistance path for the return current. The new New York Harbor electric buoy system is deservedly attracting much attention and its successful operation will probably be followed by similar harbor lighting, both here and abroad.

ELECTRIC TRANSPORTATION DEPARTMENT.

TO IMPROVE CHICAGO STREET RAILWAY PRACTICE.

Mr. C. L. Bonney, president of the West and South Town Street Railway Company, and vice president of the Chicago General Railway Company, returned recently from a three months' tour of the capitals of Europe, where he has been studying city railway transportation. Mr. Bonney was entertained by the transportation companies of nine European capitals and was offered every courtesy and assistance to his investigations.

"The object of my trip was to obtain information in the principal cities of Europe as to the operation and control of street railways and to gather material to be incorporated into a general ordinance, which we intend to draw up and place before the city council, based upon the police regulations of street railways in the old world, where they are operated from the best public standpoint of any in the world. Here in Chicago the individual roads are told to do this and that by the municipal fathers. It is 'South Side company, do this,' and 'West Side company, do that.'

"We contend that this is all wrong. The government can't pick out an individual and say 'do this' and 'do that.' It is the same in the case of corporations. While the governments of Europe are in themselves individual governments, ours is supposed to be one of equal rights. My object was to get at the systems of the old world and embody the principles which I found into a general ordinance to regulate all street railway companies of the city. I found in existence there one ordinance which requires that any conveyance used by street transportation companies be approved by the police department before it is allowed to run. Under this law the police department requires that every passenger shall have a seat. Here what there is of this sort of inspection is done by the commissioner of public works. It is not his business.

"Our policy will be to attempt to make it a police regulation and under the control of the superintendent of police that people shall not be packed into cars like sardines. Some Chicago companies say they can't carry everybody and give everyone a seat. One of the London companies carried 33,000,000 passengers last year and gave each person a seat. A Berlin company carried over 30,000,000 in the same way.

"Over 90,000,000 passengers rode in London on the various lines last year and each one had a seat. That is more than the number carried in Chicago last year. These London and Berlin companies are all subjected to a severe competition. Chicago companies have no competition. They have a monopoly of the business. Under police supervision of city transportation everyone who rides would have a seat. Any company which claims that it can't do this is trying to mislead the public. The secret of the thing is that it costs less money to pack people into cars like cattle. In St. Petersburg and Moscow seats are provided on the top of all cars, and one wishing to go up pays a half-rate. In short, there isn't a capital in Europe where the police allow crowded street cars.

"From a public standpoint, the management of Chicago's street railway system is worse than that of any of the cities I have visited. Another police regulation in Europe is in regard to horses used to draw cars. If a protest is made by the department of police in regard to an animal which is unfit for work for any reason there is no trial or long process of law, but that animal is taken back to the barn by the conductor and left there. It is the law and it is carried out. No question of private ownership is raised.

"Do they declare a dividend? Are there any profits? Well, I should say they did. The London company of which I have spoken carries its passengers at an average fare of 3 cents. A good surplus has been set aside and an 8 per cent. dividend is paid yearly on its stock.

"You can ride through the heart of London, from Charing Cross to the Bank of England, a distance about as great as from the water works to Twenty-second street, for 1 penny—2 cents. The long-distance rides cost more. The highest is 4 pence—8 cents. It would be to the interest of the companies using the graded fare to make a uniform fare for all distances. In carrying 33,000,000 the company of which I speak was required to print and check up 150,000,000 tickets. When a man pays his fare he is given a ticket, the checking up of which requires an enormous

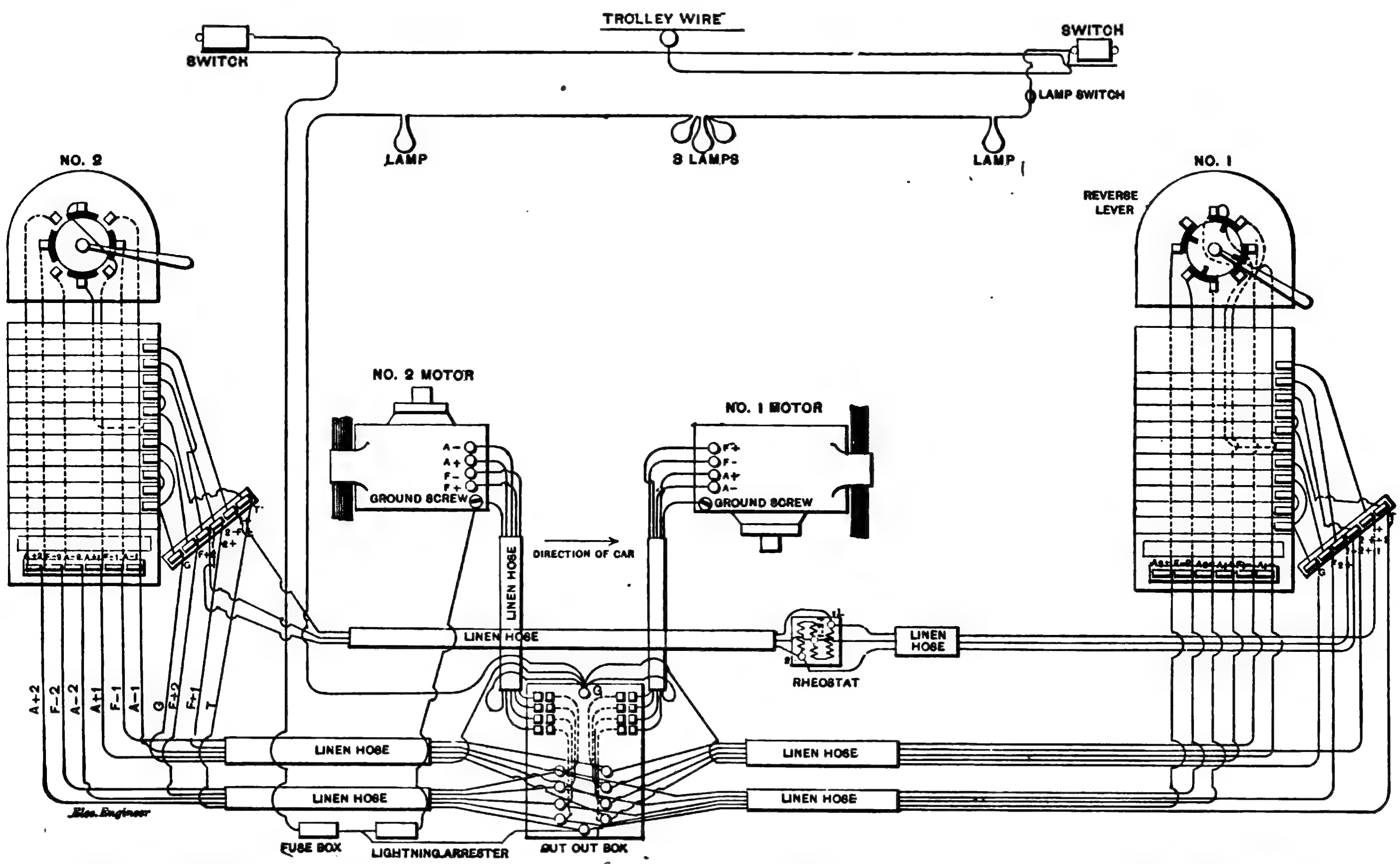


FIG. 3.—DIAGRAM SHOWING CONNECTIONS AND CAR WIRING WITH SERIES PARALLEL CONTROLLER.—*(See Page 235).*

expense for clerical work. A large profit is thus eaten up. All of this has to come out of the 3 cents a ride.

"In Paris omnibuses, street cars, storage batteries, electric and compressed air motors are used. The rates are the highest there of any in Europe."

ELECTRIC CAR WIRING.

In an interesting lecture given before the Brooklyn Electrical Society, Mr. Daniel O'Mahony described the operation of electric cars, and gave in detail the method of wiring, illustrating his remarks with diagrams of the Westinghouse car wiring plan.

The regulation for speed is obtained by means of the series parallel controller, Figs. 1 and 2 showing the various connections diagramatically. The numbers represent the following combinations:

1. The two motors and rheostat are connected in series. 2. The motors and half the rheostat are in series. 3. The two motors are in series. 4. The two motors are in series, with the rheostat in shunt with one of them. 5. The motors are in series and half the rheostat in shunt with one of them. 6. The motors are in series, with a dead shunt around one of them. 7. One motor working. 8. Motors in parallel, the rheostat in series with one. 9. Motors in parallel, half the rheostat in series with one. 10. Motors in parallel.

The diagram, Fig. 3, shows the wiring of the car, and illustrates the action of the controller and reverser, which is shown in plan above the controller.[1] The controller No. 1, shown at the right, has the reversing lever set for the car to go "ahead." At the left, No. 2, the lever is set in the position when the car is not working. Following out the wiring, A + and A — designate the wires connected to the armature binding posts respectively; and the figures 1 and 2 refer to the motor to which the respective wire is connected. Thus, A + 2 means the wire connected to the positive terminal of the armature of No. 2 motor. In the same way F stands for the field connections with the same numerical designation, and G for the ground wire. There are in all 13 wires

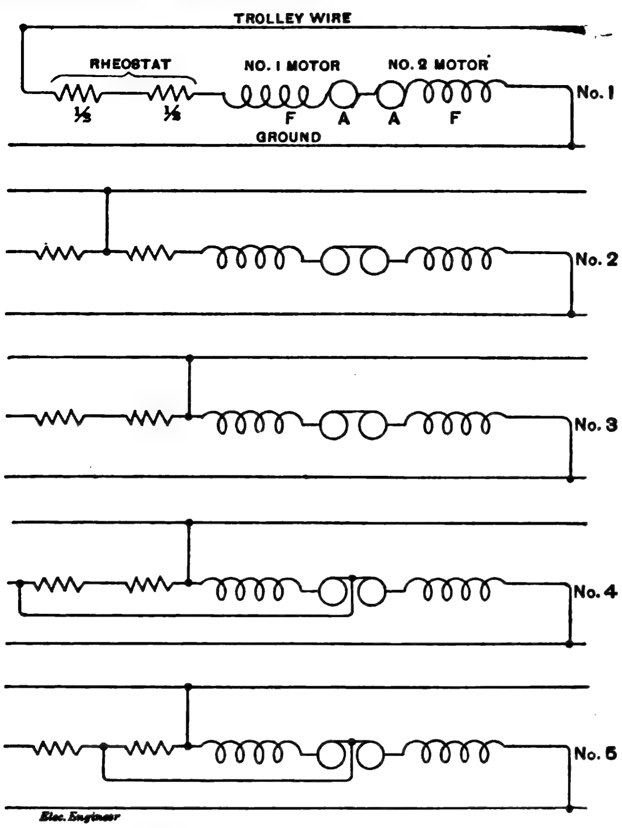


Fig. 1.—Series-Parallel Controller Connections.

going from controller to controller; 8 motor wires, 3 rheostat, 1 trolley and 1 ground wire. These wires are joined to their respective binding posts in the cut-out box, except the rheostat wires. There are also short wires going from the binding posts to the motors and ground, and one wire which goes to the trolley pole. This latter wire is led to the fuse box and passes through two overhead switches, and through a fuse box, so that when the switches are turned on the overhead wire is in direct contact with the controllers. The ground wire is grounded on the motor, which rests on the axle, current passing through the wheels to the ground.

Tracing the current from the trolley wire to the ground it first passes down the trolley pole to the cut-out box; from there to the controller and enters the ring of the cylinder which makes contact with the trolley finger on the back; passing into the contact marked 1 + the current flows through the wire to the rheostat binding post 2 —, and then by wire F + 1 to the contact on the controller 2 — F +. From there the current is led around the field magnets, returning by wire F — 1. Thence through the medium

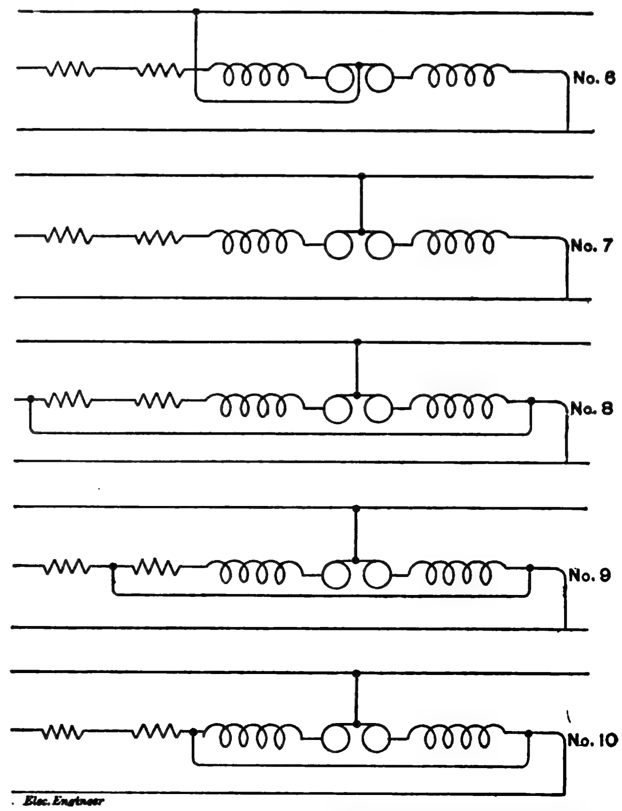


Fig. 2.—Series-Parallel Controller Connections.

of the reverser the current passes over the wire A — 1 to the armature, returning by A + 1. The reverser joins this wire to A — 2 which carries the current to the armature, returning by A + 2 which is connected to F — 2 in the reverser. Current flows through this wire around the field magnets returning by F + 2. This wire is connected with a finger which is in contact with a ring on the cylinder; this ring is connected with the ring below it which makes contact with the ground wire G. The current flows through this wire to the cut-out box, and then to the ground screw on the frame of the motor. As the motors are placed in reversed position on the axles the connections must be such that the current passes through them in opposite direction, in order that the armatures may rotate in the same direction, which is necessary in order to have them work in unison.

1. Through an error of the engraver the wires connecting to the Reverse Lever No. 1 are incorrectly drawn. The connections are, however, identical with those of Reverse Lever No. 2 shown at the left.—Eds. E. E.

A VICE CHANCELLOR DENOUNCING TROLLEY ROADS.

After hearing both sides on the petition for an injunction to restrain the New Brunswick Trolley Company from building an electric railway line between New Brunswick and South Amboy, Vice-Chancellor Pitney, of New Jersey, granted a temporary restraining order and also a rule to show cause why a permanent injunction should not issue, the same to be returnable on September 3.

The Vice-Chancellor also took occasion, in giving his decision, to denounce trolley roads in general. He declared that electric companies were in the habit of going to work and tearing up roads and laying down their tracks at night the moment they were granted a franchise, so that they could plead, when action was brought against them, that the nuisance, if nuisance it should be proved, existed already and was not about to be placed there, but he did not propose to accept any such argument, although he would be bound to decide the subject according to the law.

The Vice-Chancellor said that the companies, so far as he could learn from observation, invariably obtained desired franchises if they kept pressing their petitions long enough, and that then they appropriated the highways and went thundering along them regardless of the wishes of the people. He called this

downright robbery, and said the companies should be made to pay. If it could be shown that the proposed electric road on the narrow roadway would spoil that street for the use of other vehicles, which he was willing to believe it would, he should grant the permanent injunction.

Mr. Pitney said the insertion of a clause in the ordinance limiting the speed on the proposed road to twenty miles an hour indicated that it was intended to run the cars at that speed, which would clearly be as dangerous as steam cars.

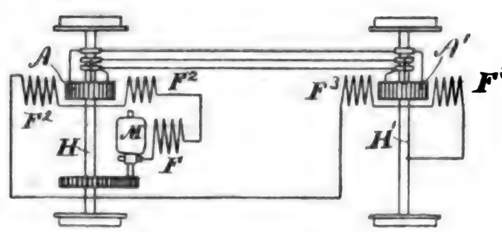
THOMSON AND RICE'S METHOD OF SYNCHRONIZING RAILWAY MOTORS.

It is a matter of common observation that owing to unequal loads at the two ends of an electric car, or the condition of the track, the wheels at one end may slip, while the wheels at the other, having firm adhesion, drive the car. In this case, one of the motors will race, and because the motors are in series the current will be cut down by counter electromotive force, so that the single motor becomes unable to drive the car, and if the slipping be prolonged the car may even come to a stop.

One of the methods tried for overcoming this difficulty, has been the connection of the motors by cranks and connecting rods; but this has not proved entirely successful in the past. When applied to cars having swivel trucks, as is usual in long cars employed for heavy traffic, the mechanical difficulties make the method prohibitive.

To secure the desired co-action of the motors on a car, Prof. Elihu Thomson and Mr. E. W. Rice, Jr., have devised a method by which the motors are maintained at synchronous speed electrically, just as if they were connected by mechanical means. The arrangement is, of course, applicable to a variety of work, but that specially adapted for electric cars is shown in the accompanying diagram.

In this figure the armature M of a continuous current motor is



Thomson and Rice's Method of Synchronizing Railway Motors.

geared to an axle H. Upon this axle is placed directly a second armature A, energized by field-coils F^2 F^2 in series with the field-coil F, energizing the armature M. Upon the second axle H^1 is placed another armature A^1, furnished with field by the coils F^3 F^3, also in series with the other field-coils. These armatures A and A^1 are wound on the multiphase system only, and are connected by collecting-rings and leads.

The operation of the device is as follows: The continuous current armature is driven by the line current, and acts also as a generator of multiphase currents through the collecting-rings and leads. So long as the speed of the two armatures A A^1 is the same, the two electromotive forces in the multiphase system balance and no current passes; but should one increase in speed a difference of electromotive force is produced, and one machine generates a current driving the other as a motor, tending to maintain synchronism of rotation. At the same time the loss of energy in the driving-armature acts as a brake to slow it down until the opposing forces again balance and the two armatures revolve at the same speed. The greater the difference in speed the higher the opposing force, and as the effects are practically instantaneous and the resistance of the leads and armatures comparatively small unison of revolution is secured.

Such an arrangement is particularly adapted to the high-power locomotives required in trunk-line business, as two, three, or even more motors may be employed without mechanical connections between the driving-wheels, the armatures insuring unison of action and equal distribution of strain over the framing of such high-power machines. It is manifest that reduction gears may be introduced into such a device, or the motors might be located on different parts of the train and their synchronism maintained.

NO RIGHT TO USE ANOTHER ROAD'S TRACKS.

An important railway decision was rendered by Judge Tuley of Chicago recently in the suit of the General Electric Street Railway of that city to compel the Chicago Street Railway Company to allow the electric company's cars to run a short distance over the Chicago's lines. Judge Tuley decided against the General company, holding that the railways are not public property, and can be controlled exclusively by the company operating them.

PEOPLE WHO WANT TO GO SLOW.

Apropos of the fast time made by the racing trains between London and Aberdeen, London *Engineering* says:

It will be remembered that the railway race to Scotland in 1887 caused many old ladies, mainly of the male sex unfortunately, to vent their alarm in the newspapers. We note that the accelerated service to Paris is calling forth quite similar effusions. Thus Mr. E. Henry Lee, of Birmingham, writes to the *Times* protesting against the high speed on the French lines near Calais, stating that a wagon of a train in which he was traveling got off the rails there. No harm was done, it appears, as the brakes pulled the train up without damage. As there are plenty of slow trains, it is difficult to understand why individuals who are afraid of high speeds do not travel by them, instead of writing to the papers with a view to inconveniencing those who like to reach their destinations quickly, and are prepared to accept any slight additional risk involved.

STORAGE BATTERY CARS FOR PHILADELPHIA.

It is announced that the Southern Passenger Railway Co., to operate the Carpenter and Reed street lines in Philadelphia, will in all probability equip its road with storage battery cars, each car to have battery power for a run of 70 miles.

DECLINING TO CARRY THE MAILS.

The directors of the Springfield, Mass., Street Railway Company have voted not to accept the United States Government proposition for the transportation of mail. This is the first case of refusal on record on the part of a railroad corporation.

IS ANYONE ANXIOUS TO PAY FOR COPPER RAILS?

Copper rails!

What a throbbing thrill of anticipatory joy coursed through the veins of the copper bulls as this novel and pregnant suggestion was made upon the "street" yesterday.

"Copper men say that it is found that steel rails under ground rust and become damp, which dampness operates against the conductivity of electricity, and consequently there is talk of adopting a hardened copper rail."

This was the sum and substance of the news item that found its way into the quiet precincts of the brokers' offices yesterday, but its latent possibilities could not be hidden by the modesty of its phraseology, and the copper enthusiasts straightway began to figure out how many $12 dividends a month Boston & Montana, or Quincy, or Osceola would pay to their fortunate owners if the steel rails of the country should be replaced by hardened copper ones at 15 cents a pound.

Just as they were figuring along this line another stray news item came over the wires to the effect that western railroads are buying 30,000 tons of steel rails this week alone, and that negotiations for 18,000 tons more are under way.

Now, if these 48,000 tons were only tons of copper!

But the thought was too seductive to dwell upon very long, and with mingled hopes and fears as to the reality of the vision, the traders returned to their everyday task of hammering or elevating Montana.

Perhaps this is why the copper producers are holding off for 18 cents a pound? If racing yachts can be sheathed with aluminum, or covered with Tobin bronze, why not copper rails and copper ships?—*Boston Globe.*

The New Brunswick-Millstone Branch of the Pennsylvania Road is the next, it is said, to be equipped electrically. It has been run at a loss of about $10,000 a year, but the change will not only enable it to compete with the new trolley lines, but, it is said, put it in condition to earn a small profit.

The Street Railway Men of New England, to the number of 75, had a pleasant gathering on August 21, visiting Newburyport and dining at the Pines on the Merrimac.

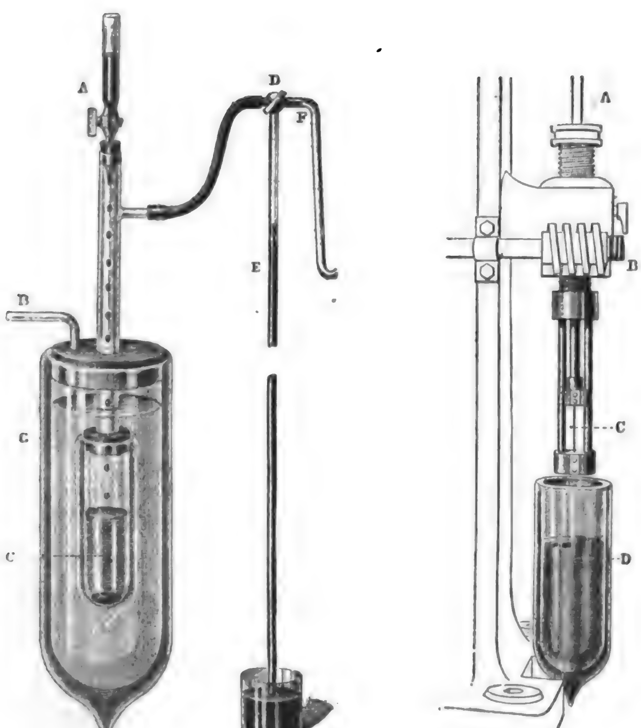
"STANDARD."

The New York Electrical Engineer is full of interesting matter. This is the oldest electrical journal in America, and is sought after far and wide by all electricians. It takes advanced ideas upon electrical subjects, and has won for itself the name of the Standard Electrical Journal.—*Kansas City Architect.*

SCIENTIFIC USES OF LIQUID AIR.[1]—III.

BY PROF. J. DEWAR, F. R. S.

The same principle is used when the latent and specific heats have to be determined. Fig. 5 shows the general plan of the apparatus. Now a definite quantity of heat has to be conveyed into the inner vacuum vessel containing liquid air, with the object of finding the weight of liquid that distills off on the one hand, or the elevation of temperature in the liquid that takes place on the other. For the purpose of adding a given quantity of heat it is convenient in some cases to use mercury (as represented in the figure), or to lower a piece of platinum or silver, or even glass, into the inner vessel; each unit of heat supplied evaporates a definite amount of air, which is readily ascertained by collecting the gas which comes off during the heat conveyance. In Fig. 5, A is the mercury, C the inner vessel of liquid air, D a three-way stop-cock, F a tube for collecting the air given off; E is a barometric tube for observing the pressure when the inner vessel is exhausted. In a latent heat determination all that is necessary is to weigh the mercury added, and to measure the amount of air by volume which has distilled from the liquid state. If the specific heat of the liquid is wanted, then the inner vessel is exhausted (as well as the outer) through the tube F to about ½ in. pressure, and the three-way stop cock turned so as to shut off F and connect the inner vessel with the manometer E. Mercury is now dropped into the inner vessel until the manometer rises to the atmospheric pressure or the liquid reaches its boiling point under atmospheric



FIGS. 5 AND 6.

pressure. Care must be taken to prevent the drops of mercury falling exactly in the same place, otherwise a mercury stalagmite grows up rapidly through the liquid, vitiating the results. Another objection to the use of mercury arises from the drops causing the rebound of small liquid air drops, which strike the cork and get evaporated away from the main body of liquid. The amount of mercury added conveys the necessary amount of heat needed to raise the given amount of liquid from its boiling point under ½ in. pressure to its boiling point under 30 in. The relative pressures give the temperature range, and the weight of liquid air or other gas under observation is easily ascertained, together with the weight of mercury added. In this way the latent heat of liquid oxygen at its boiling point is about 80 units, and the mean specific heat between —108 deg. and —182 deg. is 0.39.

Seeing that the most powerful chemical affinities are in abeyance at very low temperatures, it is a matter of great interest to ascertain what change comes over the physical force we name cohesion.

Here we are dealing with the molecular forces which are effective in uniting together the particles of solid bodies, in contrast to the force we name chemical attraction, which exists most characteristically between dissimilar molecules. Both are alike in this respect, that they are insensible at sensible distances. If we accept the theory of matter which regards finite heterogeneousness of the most homogeneous bodies as proved, then Lord Kelvin has shown that gravitation alone would account for the so-called cohesive forces. Thus, he says ("Popular Lectures," Vol. I. page 60): "But if we take into account the heterogeneous distribution of density essential to any molecular theory of matter, we readily see that it alone is sufficient to intensify the force of gravitation between two bodies placed extremely close to one another, or between two parts of one body, and therefore that cohesion may be accounted for without assuming any other force than that of gravitation, or any other law than the Newtonian." Another view of the cohesive forces is taken by Mr. S. Tolver Preston, in his work entitled "Physics of the Ether," page 64. He says, "The phenomena of 'cohesion,' 'chemical union,' etc., or the general phenomena of the aggregation of molecules, being dependent on the molecular vibrations as a physical cause, it would therefore be reasonable to conclude that variation of vibrating energy (variation of 'temperature') would have a most marked influence on these phenomena, as is found to be the fact. Further, since when a physical cause ceases to exist the effect also ceases, it follows that at the absolute zero of temperature (absence of vibrating energy) the general phenomena of 'cohesion,' including the aggregation of molecules in chemical union, would cease to exist." If this theory is pressed so as to include the gaseous state, then at the temperature of —274° C. we may imagine the particles reduced to an incoherent layer of dust or powder. The experimental facts do not, however, warrant this conclusion, seeing that at the lowest temperature reached, which is about — 210° C., air remains a transparent jelly.

That a low temperature causes profound changes in the elastic constants of a metallic body is most easily shown by placing a rod of fusible metal in liquid air, and comparing the deflection produced by a weight when the rod is supported at one or both ends before and after cooling. The Young modulus is increased to between four and five times its amount at ordinary temperatures. In the same way, the rigidity modulus can be shown to be greatly changed by cooling a spiral spring made of fusible metal wire. Such a spring at the ordinary temperature is quickly drawn out into a straight wire, by attempting to make it support an ounce weight. The same spiral, cooled to —182° C., will support a couple of pounds, and will vibrate like a steel spring so long as it is cool. In the same way, a bell or tuning fork of fusible metal gives a distinct metallic ring at —180 deg. If two tuning forks are taken of identical pitch, and one cooled to —182 deg., then on simultaneously striking them beats are very distinctly heard. The simplest plan of getting some idea of the change in the cohesive force at low temperatures, is to ascertain the tenacity or breaking stress of the metals and alloys under such conditions, and to compare such results with similar experiments made at the ordinary temperature with the same metallic samples, using the same apparatus. In this way the comparative values are reliable. The only difficulty is the large quantity of liquid air or oxygen required to cool the steel supports of the wires, which have to be broken. Seeing that wires less than one-tenth of an inch in diameter are unreliable, good strong rigid steel supports are needed, and as these have to be cooled each time a wire is broken, the experiments involve large quantities (gallons) of liquid air and oxygen. Further, as not less than three, and in many cases six experiments must be made with each sample of wire, and the stress in each case can only be applied slowly, work of this kind extends over long periods of time, and this means increased waste of liquid gases. Fig. 6 shows the general plan of the part of the testing machine which supports the wires which have to be broken. In the figure, A is the steel rod which is connected to the multiplying levers, the stress being gradually increased as usual by running in water into a vessel hung from the long end of the lever; C is the wire to be tested, B is an arrangement which measures roughly the extension of the wire, and D is a large silvered vacuum vessel holding the liquid oxygen. This latter vessel must be large, in order to avoid any part of the supports of the wire coming into contact with the sides, otherwise the shock of the wire on breaking shatters the vacuum bulb. The rupture must be made while the wire is immersed in the liquid oxygen, and the whole of the supports thoroughly cooled down. The wires must be caught in long V-shaped grooves made in the steel supports in order to avoid slipping, and change in the cross-section of the wire. As a rule, the wires used were one-tenth of an inch in diameter and 2 in. long. The following table gives the mean results of a large number of experiments :—

TABLE I.

BREAKING STRESS IN POUNDS OF METALLIC WIRES 0.098 IN. DIAMETER.

—	15°C.	—182°C.
Steel (soft)	420	700
Iron	320	670
Copper	200	300
Brass	310	440
German silver	470	600
Gold	255	340
Silver	330	420

An inspection of this table proves that all the common metals and alloys increase in tenacity at low temperatures; thus iron has doubled its breaking stress, and the other metals and alloys are all increased from a third to a half the normal amount. This increase of strength is solely due to the low temperature, and persists only during its continuance. Wires that have been cooled to the temperature of —182° C. and allowed to regain the ordinary temperature, are in no way changed as regards their breaking stress.

THE FISHER AUTOMATIC CUT OFF ROTARY ENGINE.

There is on exhibition in the Cadillac Hotel, Detroit, an automatic cut-off rotary engine which is claimed to be as economical in its use of steam as the best reciprocating engine and which combines some points of novelty not heretofore embodied in engines of this class. The engine is the invention of Mr. Chas. A. Fisher of Petersburg, Ill., and its dimensions are as follows:

Base 8′ x 28″; height to centre of driving shaft, 32″; extreme height 6′; total weight 2 tons; nominal horse power 50; two cylinders, diameter 12″; length 21⅛″; mean area of piston 32.25″; size of feed pipes 1½″; exhaust pipe, 3″; speed 350 revolutions per minute.

Our engraving, Fig. 1 shows the engine in perspective. Fig. 2 shows the longitudinal sections of left hand cylinder and the elevation of right hand cylinder with longitudinal sections of the steam chest valve, etc., the cut-off being removed in this view. Fig. 3 shows the cross section of both cylinders. The actuating device controlling the cut-off is a modification of a design by Richard Hartnell. This form was selected on account of its neat appearance. Any form of hyperbolic governor can be used effectually, as the range of movement for control from full load to no load, is 1⅛ inches in a straight line.

Steam from the boiler is admitted at the top of the stand S, which furnishes a support for the governor brackets and follows the passage around the steam chest D outside of the valve K¹ and is admitted at the end of the valve which is hollow. The valve is provided with two rows of perforations for the passage of the steam to the induction ports, the rows of perforations being radially opposite, and the valve driven by gear from the driving shaft of the engine in a ratio of two revolutions for the engine to one of the valve. By this arrangement the perforations alternate in furnishing steam to the cylinders and also maintain a which is half-stroke in this engine. The variable cut-off, L¹ within the valve, is arranged to be rocked by the action of the governor as the load may demand, to close the perforations in

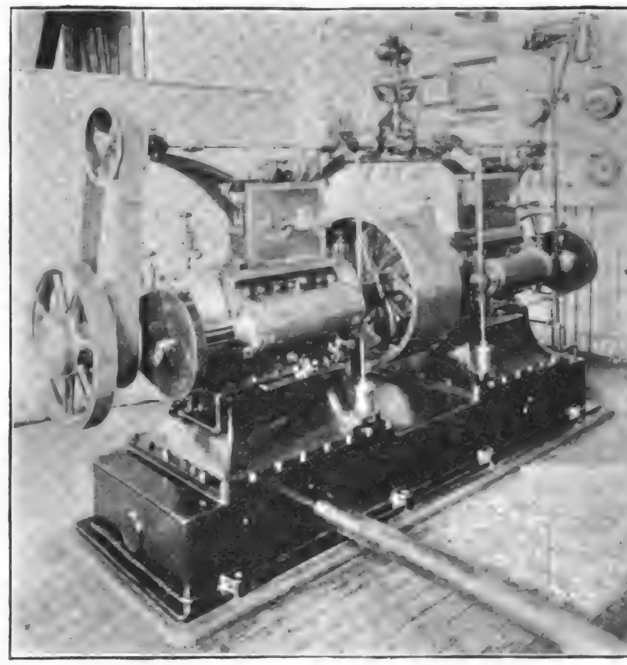
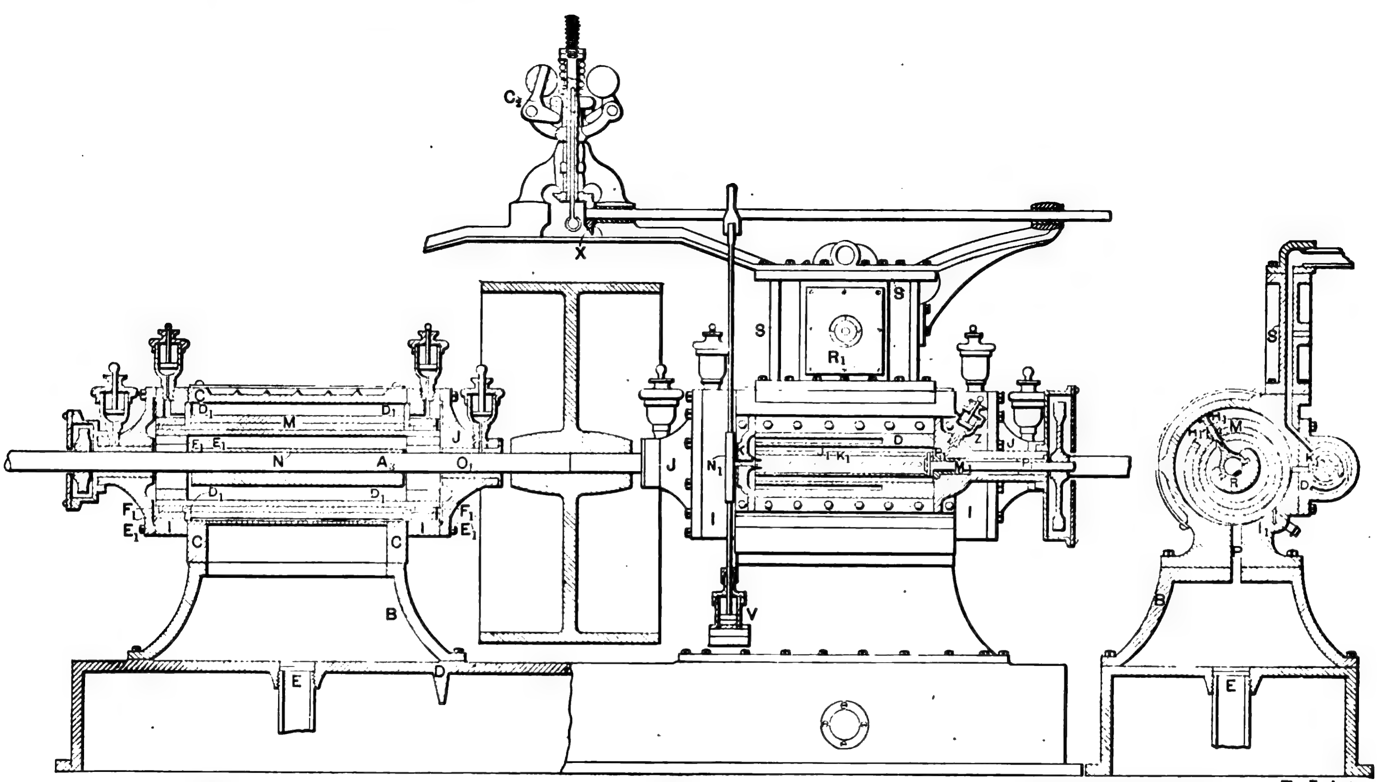


Fig. 1.—The Fisher Rotary Steam Engine.

the valve at an earlier point in the stroke than would be done by the fixed cut-off.

The piston N, is keyed on the driving shaft, which is concentric with the bore of the cylinder and runs in phosphor bronze bearings 6 inches in length, located in the outer caps J. The tubular



Figs. 2 and 3.—The Fisher Rotary Steam Engine.—Longitudinal and Transverse Sections.

constant point of admission. The valve finds its seat in a cylindrical supplementary lining J¹ in the steam chest, in which is provided a row of gridiron openings covering an arc of 60 degrees in the lining.

The circular length of these openings plus twice the width of the perforation in the valve, determines the point of fixed cut-off, wheel M through which the piston passes, is mounted concentric with the bore of the cylinder, finds its bearings in the cylinder heads I, and forms an abutment with an adjustable bearing plate I¹ located in the wall of the cylinder between the induction and exhaust port.

The wheel M consists of a hollow steel shaft carrying cast iron

sleeves of equal thickness, the inner sleeve being securely fastened to the steel, the outer sleeve so constructed by a spiral "parting" as to be laterally expansible for the purpose of taking up end wear and maintaining steam joints between the chilled iron head linings D^1 with which it forms an abutment. The piston is provided with a radial T-shoe held against the inner walls of the cylinder by light springs, also with triangular plates at either end held outward laterally by springs, thus compensating for both radial and end wear. The dash pot V is for the purpose of preventing undulatory movement of cut-off.

The indicator diagram Fig. 4 was taken with the engine located 80 feet from the boiler, exhausting into the heater of the Cadillac Hotel plant, resulting in a constant back pressure of from three to four pounds. Wire drawing of thirty pounds indicates insufficient area of pipes or valve opening, and precludes an accurate estimate of results to be obtained in steam economy, but the mechanical efficiency is remarkably high, 97 per cent. being shown by the card. The indicator diagrams were made with a "Perfection" indicator adapted by Mr. Fisher for his engine by substituting the card cylinder connected to gearing by universal joints and rotating synchronously with the piston. The paper was formed in a tube to fit the card cylinder, and afterward cut longitudinally between points of admission and exhaust. The constancy of the engine as shown on the diagrams, is noteworthy, each card showing two distinct diagrams at different loads, each line of which was traced by indicator pencil not less than 20 revolutions and yet but one line was discernable.

The engine was built by the Leland & Faulconer Manufacturing

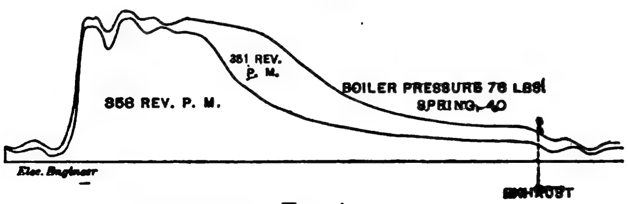


FIG. 4.

Co., under Mr. Fisher's supervision, was completed about the 15th of May and has been in constant service since that time. The first engine of this kind was built in Chicago in 1891, and was a model, the cylinder being 5" long and 5" in diameter. This little engine has been used since in the experimental laboratory of Messrs. Fisher & Abbott at Petersburg, Ill., furnishing power for their works.

Provision has been made in this engine that parts subject to most wear can be replaced at small cost; as there are no steam joints to be maintained by the use of soft packing it is calculated to require but little attention. Its construction admits of perfect balancing of all parts, a fact which makes a foundation unnecessary.

This engine can be operated as shown, or as two distinct engines as circumstances require. For the purpose of direct connected lighting or power plants of small or medium dimensions this engine can be used advantageously. Where the two engines work together, the dynamo can be placed in the centre, or where there is only one engine used the dynamo can be put at one side. The latter arrangement is well adapted for train and ship lighting where space is an object. The double cylinder engine is so set that there can be no dead centre, so that there is no difficulty in getting an engine started at any time.

It is intended to build these engines with regular fly wheels in future, those shown in the illustration being merely intended as light band wheels.

OBITUARY.

D. W. KISSAM.

The death is announced of Mr. D. W. Kissam a director of the Bridgeport Brass Co. and president of the Bridgeport Electric Co. He had been a citizen of Bridgeport since 1859, when he became connected with its brass interests. His death, at the age of 58, was due to apoplexy.

HENRY METZGER.

We regret deeply to note the death of Mr. Henry Metzger, of Pittsburgh, a veteran telegrapher and a pioneer telephonist. He was the general manager, &c., of the Central District & Printing Co., which owned the Pittsburgh exchange and a large slice of adjacent telephone territory, and took the deepest interest in the technical part of the work. He was at one time president of the now defunct Telephone Exchange Association, and also served in the Pittsburgh city council. He was unmarried but was the centre of a large circle of friends, who appreciated the kindliness and thoroughness of his nature. He was born in 1840.

PERSONAL.

MR. O. P. LOOMIS, of Bound Brook, N. J., has resigned his position as electrical engineer of the American Engine Co. of that place. There are a number of enterprises which he is considering while he is enjoying a well earned rest.

VERMONT OLD TIME TELEGRAPHERS.

Concerning the Vermont and Boston Telegraph company, the *West Randolph Herald* gives the following interesting reminiscences:—

The company was one of the first in operation and furnished from its operators many men who had done important service in the development of telegraphy. It was leased to the Western Union Company but its corporate existence is still kept up, and one meeting a year is held for that purpose.

Charles A. Tinker, the vice-president, was born in Chelsea and was the operator at Northfield in the early fifties, while Col. Robert J. Kimball was his "next door neighbor" here in our village, and Col. A. B. Chandler was taking his first lessons in telegraphy of Col. Kimball at the same time. The latter continued as an operator only a few years but has been identified with telegraph companies and has for many years been elected a director of the company for which he served as one of its first operators. Both Mr. Tinker and Col. Chandler have devoted their lives to the science and have filled some of the most important positions during their honorable careers.

While the war was in progress, they were selected as the two most trusted operators in the war office at Washington, and President Lincoln and Secretary Stanton frequently spent whole nights with them translating despatches into cipher for transmission to the heads of the army. Since then, they have been, to a great degree, responsible for the wonderful growth of the companies.

These then telegraph "boys" have made successful business men and are much respected wherever they are known. They all have homes in Clinton avenue, Brooklyn, N. Y., as well as residences in Vermont—Mr. Tinker at St. Albans, and Col. Chandler and Col. Kimball in Randolph, the home of their boyhood, where they learned the telegraph alphabet.

They have been most cordial friends for more than 40 years, and though for a while living in different states, they have never ceased to be most loyal and enthusiastic Vermonters, and enjoy their Vermont homes more than ever.

SOCIETY AND CLUB NOTES.

NEW YORK STREET RAILWAY ASSOCIATION.

The annual meeting of this Association, which does much excellent work in a quiet way, is to be held at Albany on September 17. A number of interesting papers have been prepared and a most interesting series of topics for discussion has been formulated. President Rogers, of Binghamton, reports that there is a revived interest in membership and that seven or eight roads have joined recently. A large attendance is expected and supply-men are cordially invited to join in making the occasion a great success.

PEORIA, ILL.—The Order of Railway Telegraphers has made Peoria its permanent headquarters. W. V. Powell, grand chief, and J. R. T. Auston are already in residence there.

OLD LAMPS FOR NEW.

At Camden, N. J., slick swindlers are going around claiming to be representatives of the Camden Lighting and Heating Company, and saying they were sent to place new electric light lamps in the houses of persons using electricity. They take away the good lamps and leave broken ones in the sockets.

THE ATLANTA ELECTRIC FOUNTAIN.

The lower lobe of the lake, on which the Electricity and Transportation Buildings of the Cotton States and International Exposition front, is nearly full of water and three streams from six-inch mains have been turned on the upper basin which fronts the Machinery Hall and the Mines and Forestry Building. The electric fountain is in the centre of the upper basin, and the operating chamber is complete.

THE ESSEN COAL COMPANY'S ELECTRIC MINING PLANT.[1]

BY TIMOTHY W. SPRAGUE.

A few miles from Pittsburg, at a station on the P. C. & Y. Railway called Hazletine, is the largest electric power plant for coal mining purposes in the United States, and one of the largest in the world. It is installed to operate No. 2 and No. 3 mines of the Essen Coal Company, of which Mr. J. C. Dysart, of Pittsburg, is general manager, Mr. William Baldwin, superintendent, and Mr. F. A. McDonald, engineer.

Mr. Dysart made a thorough investigation of coal mining machinery plants, and came to the conclusion that where trouble developed with such plants, it was nearly always traceable to insufficient power. Accordingly it was decided in laying out this plant to allow an ample margin of initial power.

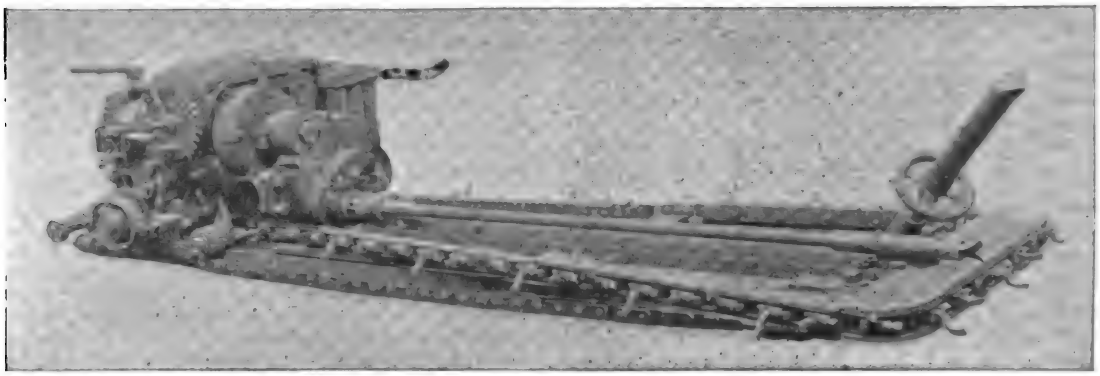


FIG. 1.—ELECTRIC COAL CUTTER EMPLOYED AT THE ESSEN COAL MINE.

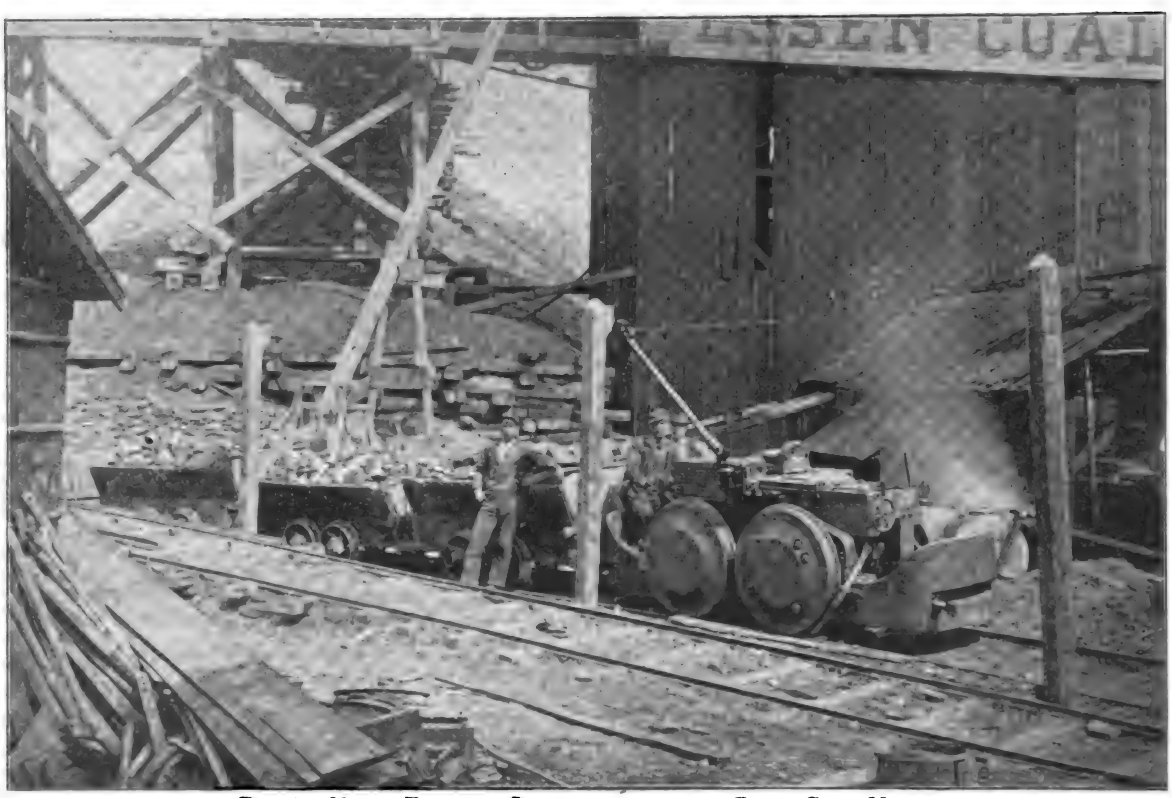


FIG. 2.—80 H.P. ELECTRIC LOCOMOTIVE AT THE ESSEN COAL MINE.

The power house itself is excellent in material and construction, and in its general design and arrangement. It is a building 130 ft. long by 56 ft. wide, steel frame with corrugated iron covering. It is set on a 15-in. brick foundation, and the ceiling of the dynamo and engine room is sheathed to prevent trouble from the moisture of condensation. The west end of the building contains four Russell tubular boilers, each 60 in. in diameter and 18 ft. long, and containing 64 tubes 3½ in. in diameter.

The engine-room, which occupies the central portion of the building through its full width is 63 ft. long. It contains three automatic Corliss engines, made by the Russell Manufacturing Company, Massillon, O., with cylinders 17 in. × 24 in., running at a speed of 153 revolutions per minute. They are set on brick foundations, and have 10 ft. fly-wheels. With the steam pressure usually carried, 90 to 100 lbs., these engines will develop something over 200 H. P. each. They drive three 150 kilowatt bi-polar generators made by the Link Belt Machinery Company, of Chicago, of the "Independent" mining type, wound for 275 volts and running at 510 revolutions per minute. These 200 H. P. generators are probably the largest bi-polar machines in use to-day. The station instruments are mounted on a marble switchboard also furnished by the Link Belt Machinery Company, which company took the contract for the entire plant, delivered and erected.

The remainder of the power house building is divided into three rooms, a blacksmith and machine shop, a locomotive house and a store room, containing a lathe and some other power tools. The locomotive room is large enough to hold on its two spur tracks the two 80 H. P. locomotives now in use. It is provided with pits for getting at the under parts of the machines and an over-head crane for lifting heavy parts.

The electric power generated is used at present for coal under cutting, haulage and lighting. The plant was started in June and is not yet in complete operation. It is intended to run 16 under cutters all of the "Independent" chain type; two 80 H. P. locomotives, one in each mine for the main haulage work,

1. Abstract from *The Engineering and Mining Journal.*

mules being employed to do the gathering, and to light the tipples, power house and underground workings as may be necessary.

The coal cutter, which the illustration, Fig. 1, shows, is driven by a 20-H. P. "Independent" motor wound for 220 to 250 volts, having but one field coil. The machine is 2 ft. high, 2 ft. 4 in. wide and 10 ft. 5 in. long when closed. It cuts to a depth of 5 ft. making the cut 3 ft. 6 in. wide and 3½ in. high. The frames of the machine are made of wrought iron and steel. The chain is cast steel, as are the sockets and socket pieces. The straps are drop forged and machinery steel pins are used for putting the chain together. Cast iron is not used in any part subject to a strain. The control of the machine is easily accomplished by the movement of a lever through 180°. By this means the cutter may be fed forward, stopped feeding, or reversed without stopping the motor. Another good feature is an automatic stop on the withdrawal. Trucks are provided for transporting the machine from room to room.

The locomotives, 42 in. gauge, are single-motor, four-wheeled machines of the "Independent" type, Fig. 2. They run under load at about 8 miles per hour, exerting nearly 4,000 lbs. draw-bar pull, and are each capable of hauling 1,200 tons run-of-mine coal per day of 9 hours from the gathering points to the bottom of the slopes in their respective mines. These distances are, in No. 2 mine, 2,000 ft., and in No. 3, 3,800 ft. The ultimate length of the main haul by the electric locomotive in No. 2 will be 5,300 ft., and in No. 3, 8,500 ft.

The coal cutters are evenly divided between No. 2 and No. 3 mines, there being eight in each. In No. 2 mine their average distance from the bank-mouth is 2,000 ft., making the distance from the power house to the machines 3,400 ft. In No. 3 mine the distance to centre of machine distribution is over 4,000 ft. At the present time in No. 3 mine 7 cutters are at work, 4 of which run 10 hours per day, the remaining 3 working double shift. In No. 2 mine, 2 cutters are running 10 hours per day, 2, 15 hours and a fifth, 20 hours.

The wiring, and in fact all the installation work, has been done under the supervision of Mr. D. N. Osyor, mining engineer for the Link Belt Machinery Company. The trolley wire is everywhere No. 00 wire, held by special "Independent" mine insulators. The only insulated wire used is in the leads to and from the switchboard and about the tipples and station, where lights are used. A ground return is used throughout, the coal cutters being operated on the grounded circuit. The rails are all 40 lbs. per yard, with fish plates, heavily bonded and cross-bonded at suitable intervals. The return is reinforced from the bank mouths to the power house by three No. 0000 aerial wires from each.

The lighting of this plant is an especial feature. In each tipple, and at all switches, etc., in the mine where a light is advisable, the special "Independent" mining arc light has been placed. This peculiar form of lamp with horizontal carbons gives an excellent illumination for underground work. The difference in the size of the carbon keeps the arc practically central, and although the lamps are run with a resistance in series, the loss is unimportant in a plant of this kind. In and about the power-house, shops, etc., 50 incandescent lamps of 16 C. P. each furnish illumination, run three in series. The locomotives are furnished with arc headlights with powerful reflectors.

BAD LANGUAGE CAUSED BY LIGHTNING.

While old Pluvius has not shed many tears in Chillicothe for some time, he has wept in the country round about, and has given an exhibition of temper, too, which made old Jupiter mad, and which was not at all to the liking of some people who saw old Zeno flash his thunderbolts. The case to which especial reference is made, occurred in South Union township, on the Egypt road, on the farm of Mr. Charles Hurst. A day or so ago the ruler of the gods sent out a streak of lightning to clear up the atmosphere, and while the aforesaid electrical fluid was on its way to earth, it came in contact with Mr. Charles Hurst's barn.—*Chillicothe, O., Gazette.*

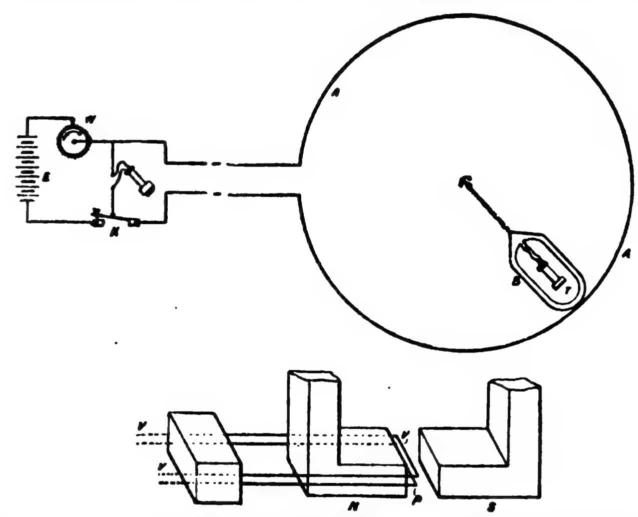
THE GREAT LAKES TO RUN SHALLOW.

It was a typically enterprising plan for Chicago to use the Great Lakes to flush out its sewerage in the new Drainage Canal, but army engineers appointed to investigate now complain that this unauthorized work, nearing completion rapidly, threatens to reduce the general lake level six inches. It would be serious if Lake cities found themselves high and dry like some of the old Cinque Ports in England. Not less serious also might be the diminution of the flow at Niagara, where last week the splendid engineering enterprise went into practical, commercial operation. The utmost that the Niagara utilization would do, it is said, is to lessen the thickness of the Horseshoe Fall about two or three inches, but this Chicago Drainage Canal is to slice six inches of water off all the Lakes, except Superior, inside of two years, and shoot the water into the already overburdened Mississippi.

ELECTRIC COMMUNICATION WITH LIGHTSHIPS.

Several English lightships have been put in electrical communication with the shore, and valuable information has been transmitted with regard to ships in distress, many lives having been saved in consequence. There have, however, been several breakdowns of the apparatus, principally due to the chafing and breaking of the electric cable between the mooring and the vessel. As this is a contingency that it is difficult to avoid when the cable is led on board, a trial is to be made of the inductive system, in which the cable lies wholly on the bottom of the sea, and the signals are transmitted over the intervening space to the apparatus on board by electro-magnetic induction The apparatus to be used is the invention of M. Sidney Evershed, of Woodfield Works, Harrow-road, London, and its principle is illustrated diagrammatically in the annexed illustration taken from *Engineering*. Fig. 1, shows a lightship B, able to swing round a mushroom anchor. Around the circle which it is capable of occupying there is laid, on the sea bottom, a ring of cable A, connected to the shore station, as shown. A secondary coil is fixed on the ship, and should consist of, at least, 50 turns of insulated wire, of as low a resistance as possible. If the ship is built largely of iron, the secondary coil should be arranged around the outside of the bulwarks; its magnetic axis must be as nearly as possible normal to the plane of the ship's decks. Of course the coil must be as large as the dimensions of the vessel will permit.

Interrupted currents are sent through the submarine cable by means of a key K and a contact-breaker W driven at such a speed as to interrupt the current several thousand times a second. The discontinuous currents in the cable ring A produce rapidly alternating electromotive forces in the secondary coil, and alternate currents pass through the telephone T, and indicate their presence



FIGS. 1 AND 2.—METHOD OF COMMUNICATING WITH LIGHTSHIPS.

by the buzzing of its diaphragm. The signals are read by the Morse code.

The difficulty with inductive telegraphy lies in calling the attention of the operator, as, of course, he cannot live with the telephone at his ear. This difficulty appears to have been removed by Mr. Evershed in an exceedingly ingenious manner by the invention of a cumulative impulse relay. Several forms of the instrument have been worked out, one of them, on the principle of the D'Arsonval galvanometer, being illustrated in Fig. 2. A rectangle of wire V is clamped in an insulating support I. One side of the rectangle is placed between the poles N S of a powerful magnet, and when the rectangle is traversed by alternating currents, timed to correspond to its frequency of vibration, it receives a series of cumulative impulses, and is set in vibration. This vibration brings it against a contact on the similar rectangle P, which is tuned in unison with V. When the two touch the circuit of a local battery is closed, and a bell rung. The two similar rectangles are used to prevent accidental contact due to mechanical jars. The second rectangle may be traversed by alternating currents in the opposite direction to the first. The currents employed in calling are not the same as those for speaking. A frequency of 20 to 40 periods per second is suitable, and is obtained by means of a tuning fork or other similar device. The vessel on which the induction telegraph is to be tried in the first instance is the East Goodwin, which lies outside the Goodwins, and will require a cable of some 10 nautical miles in length.

YACHT STORAGE BATTERY LIGHTING.

Among the yachts on which the Chloride Accumulator has been installed for lighting purposes this season are the Linta, Sultana, Alcedo, Duquesne, Huntress, Washita, Vidette, Thespia.

NEWS AND NOTES.

THREE-PHASE TRANSMISSION AT BONDSVILLE, MASS.

As the advantages attendant upon the introduction of electricity into textile mills are being brought home to manufacturers by a study of the benefits already derived by other mills in which the electric motor has gained a stand, the number of plants is daily increasing. One of the latest converts to the new method is the Boston Duck Company of Bondsville, Mass., the mills of which are now operated partly by water and partly by steam. From the water they are able to derive about 600 H. P. over their present steam plant, consisting of two 250 H. P. engines; one being run condensing and furnishing power alone, the other non-condensing and being used partly for power and partly to furnish exhaust steam to the dye houses. The dye houses, however, require the exhaust steam from about only 100 H. P. Thus if the power were not required in the mill to help out the water wheels, the condensing engine could be shut down entirely and the other engine could be run at about half its capacity only.

Three thousand feet below the mills, this company own another water privilege on a difference in level of 22 feet. This was developed some years ago, and the company even went to the expense of building a foundation for a mill before they decided to give up the project. Since that time electricity has come upon the scene and the heretofore unutilized water power has now become of considerable value. Wheels are to be set up in the unused mill and 500 H. P. is to be transmitted back to the mills at present in operation at Bondsville. This will enable them to dispense almost entirely with their present steam plant.

The General Electric Company have undertaken to install the necessary electrical apparatus for this plant. It will consist of one three-phase 400 K. W. 900 volt generator and one synchronous motor of similar size, which will develop 485 H. P. on its pulley. The loss in the line has been calculated at about 3 per cent. only. In estimating the economy effected by the introduction of electricity, the Boston Duck Company have announced that they will not count the cost of the development of the second water power made in 1880, when calculating the operating expenses of the complete plant, as the money put out for the hydraulic improvements cannot be recovered and will not therefore be counted in as part of the present development.

WATER POWER AT UTICA, N. Y.

Mr. E. D. Matthews, of the Utica Highlands Co. and Syndicate, and the Trenton Falls Power and Electric Co. writes us that his company has control of a great water power, and allied enterprises, and that they would like to interest capital on favorable terms. Local capital is timid, not appreciating the extent to which water power plants are now being developed. According to Mr. Matthews, experts report that they have 14,000 H. P., at low water, at Trenton Falls, and that it could be easily and cheapily transmitted to Utica. The company holds for sale its power, and has control, it seems, of about 2,000 acres and 8 miles of gorge. Such power ought to find a ready and profitable market in Utica.

THE BRITTON PLAN FOR UTILIZING THE NIAGARA RIVER.

It is reported that William H. Britton, who is in the employ of Iribacker & Davis of Buffalo, is the inventor of a wheel or motor attached to a steel outrigger and submerged completely in a current of water. A motor like this with a 12-foot diameter and having 12 blades, submerged in a 12-mile-an-hour current (such as will be found in the gorge below the whirlpool, where it is proposed to locate them) will be expected to develop a power of from 160 to 200 horse-power. From the submerged current motor a shaft will connect with an overhead wheel, which in turn will be connected with the dynamo. The cost of each outrigger, with two wheels attached, will, it is estimated, come to from $5,000 to $6,000, and can be located every 12 feet anywhere in running water.

FIRST COMMERCIAL USE OF THE NIAGARA POWER.

A special dispatch from Niagara Falls of August 26 says:—At seven o'clock this morning the Niagara Falls Power Company first turned on the electric power generated by its dynamos and turbines from the torrent of Niagara River for actual commercial purposes. The current was transmitted to the works of the Pittsburgh Reduction Company, which a few moments later opened for business with a score of men. To-morrow morning forty men will be at work. The official beginning of the commercial enterprise was witnessed by the chief officials of the power company and affiliated concerns with great satisfaction. The current was generated by the second dynamo, and is estimated to have been about 2,000 horse-power.

SCOTCH WIND AND WATER IN WESTERN AUSTRALIA.

A special dispatch of Aug. 20 from Glasgow, Scotland, says:—An invention designed to provide motive power for the gold fields of western Australia has been patented by two gentlemen of this city. The invention contemplates the substitution of electricity and compressed air for the water power now in use. The Rothschilds and the government of western Australia have become interested in the patent, and a company will be formed with a capital larger than that of any stock company organized within the century.

HAWAIIAN CABLE.

The Hawaiian Government has granted a subsidy of $40,000 a year in aid of a telegraphic cable between the islands and the United States; and it is proposed to secure a similar subsidy from this country.

METALLIC LACTATES FOT ELECTRO-PLATING.

In connection with a paper on the electrolytic deposition, for analytical purposes, of metals dissolved as lactates or glycolates, Dr. Jordis, of Munich, pointed out that lactic acid provides an excellent solvent for electro-plating. As yet experiments have only been made in the laboratory with plates of 30 square inches surface. The deposits form so uniformly and easily, however, and adhere so well, that there is great hope for technical processes based upon Dr. Jordis' researches. The expensive free lactic acid is not required. In Germany lactic acid is quoted at 590 marks—about $145—per 100 kilograms (220 lbs.); a fairly pure acid can be obtained for 300 marks, while pure lactates of calcium and zinc, from which the acid is generally separated, cost 190 and 485 marks. Coatings of copper and brass of varying shades on iron, zinc, or copper, of zinc on iron and copper, and of iron and of nickel, can be obtained without difficulty, without any special apparatus. Whether the latter point will be confirmed in operations on a larger scale remains, of course, to be seen. As to zinc, Dr. Jordis does not appear to have been particularly successful. In any case, the process has great interest for engravers, whose blocks are not as a rule of large dimensions, and particularly for the silver-plating industry. Amalgamated brass is, in a bath of lactate of silver, covered with a pure white coating of silver, which takes the highest polish. It would be a great boon if we could replace the dangerous cyanide of potassium by the harmless lactic acid. The connection with milk might suggest bacteria, as the decomposition of the lactic acid into carbonic acid and acetal aldehyde need not, in the vat, proceed as certainly as it does in platinum dishes. But lactic acid is itself regarded as antiseptic, and the electric current, though perhaps not so fatal to micro-organisms as is often asserted, does not favor their development. The communication was brought before the second annual meeting of the German Electrochemical Society, which assembled at Frankfort-on-the-Main in the first week of June, under the presidency of Professor Ostwald.

THE INFLUENCE OF MOVING MATTER ON THE ETHER.

The problem of the motion of ether with or through ordinary matter has been again attacked by Herr L. Zehnder, who recently contributed an interesting paper on the subject to *Wiedemann's Annalen*. He endeavored to ascertain whether the ether is pushed along by atoms, or whether it passes through their substance without resistance, or, finally, whether only a portion of the ether adheres, and this portion only is carried along. Herr Zehnder's apparatus consisted of a cast-iron cylinder in which an air-tight piston moved. A small tube led out from one end of the cylinder, doubled back upon itself, and returned to the other end. Now, if the cylinder was exhausted of air, so as to leave nothing but ether behind, and the piston was then worked, the inference would be that the ether would stream through the small tube with a velocity as much above that of the piston as the ratio of the sectional area of the one to the other. The ratio was 560 to 1; and exhaustion was carried to the 40,000th part of an atmosphere. To ascertain whether the ether moved in the sense contemplated, a beam from a brilliant sodium flame was passed through two thick parallel glass plates; the second one being silvered at the back. This plate, by its two reflecting surfaces, split the beam of light into two, each part travelling through one portion of the small tube. Then the same beams were reflected back upon the thick plate, and returned along the way they had travelled, being finally reflected into the reading telescope by the first plate. Interference fringes were thus produced in the field of view, the motion of which would have indicated a movement of the ether; but no such motion was observed when the tubes were thoroughly exhausted, so that it was concluded that the ether passes through solid bodies. A similar negative result has been obtained by Dr. Oliver Lodge and others, in the efforts they have made to discover if there is any molecular drag on the ether.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED AUG. 27, 1895.

Accumulators:—

Secondary Battery, I. A. Timmis, London, Eng., 545,390. Filed Feb. 28, 1895.

An element for secondary batteries consisting of a thin sheet of metal corrugated in parallel uninterrupted continuous lines, and folded or plaited in continuous lines intersecting the corrugations.

Alarms and Signals:—

Electric Annunciator, G. J. Galbraith, Boston, Mass., 545,069. Filed Apl. 27, 1895.

Elevator Indicator, L. Malm, Cleveland, Ohio, 545,127. Filed Jan. 5, 1895.

Devices whereby a lamp can be made to glow at each successive movement of the finger and illuminate the index number on the dial of the floor indicator.

Fire Alarm Box, T. Walsh, Montreal, Can., 545.141. Filed Apl. 12, 1895.

An attachment in the form of an automatically operated grip or handcuff acting to detain the person operating the alarm until the arrival of the firemen.

Electric Signaling Device, W. Gillette, New York, 545,357. Filed July 5, 1894.

Details relating to a hotel telephone system.

Conductors, Conduits and Insulators:—

Electric Conduit, O. J. Kintner, New York, 545,296 Filed Mch. 16, 1893.

Means for maintaining a circulation of hot air through interior conduits to keep them dry and to ventilate the rooms.

Distribution:—

System of Electrical Distribution, T. A. Edison, Llewellyn Park, N. J., 545,495. Filed Dec. 6, 1886.

A system comprising high tension generators at the central station with rotary convertors reducing the potential at substations.

Dynamos and Motors:—

Means for Synchronizing Electric Motors, E. Thomson and E. W. Rice, Jr., Swampscott, Mass., 545,111. Filed March 8, 1893.

See page 000 this issue.

Commutator or Collector Brush, C. L. Coffin, Detroit, Mich., 545,347. Filed Feb. 5, 1895.

Consists of a strip of sheet metal comprising a solid non-perforated portion and perforated portions having a continuous edge.

Electrometallurgy:—

Process of and Apparatus for Refining Metals Electrolytically, W. H. Wiggin, Worcester, 545,328. Filed May 29, 1894.

The plates are constantly agitated in vertical planes.

Lamps and Appurtenances:—

Electric Arc Lamp, H. T. Harrison, London, Eng., 545,359. Filed Nov. 19. 1892.

Details of construction.

Miscellaneous:—

Hysteresis Compensator, B. Abdank-Abakanowicz, St. Maur, France, 545,042 Filed Mch. 17, 1893.

The method of correcting or neutralising the effect of hysteresis in electro-magnetic apparatus, which consists in employing in such apparatus a main and an auxiliary magnetic circuit and neutralising the effect of the residual magnetism of the first circuit by that of the second.

Thermostat, G. Hill, New Brunswick, N. J., 545,076. Filed Jan. 3. 1895.

Electric Gas Lighting Apparatus, J. W. Palmer, Nashua, N. H., 545,091. Filed Jan. 9, 1895.

Details of construction relating to the wiper.

Electro Magnetic Tool, C. F. Carpenter, Louisville, Ky., 545,149. Filed Aug. 20, 1894.

A percussion tool for cutting stone, metal, etc.

Means for Indicating Coincidence of Phase of Two Alternating or Polyphase Current Machines, J. H. F. Görges, Berlin, Germany, 545,282. Filed April 4, 1894.

An indicator for indicating when the separate currents generated by auxiliary coils correspond in potential, and a differential indicator for indicating when the said currents correspond in number of periods.

Electric Target, Milton T. Weston, Kenton, Ohio, 545,327. Filed Dec. 8, 1894.

Railways and Appliances:

Underground Electric Railway, D. F. Graham, Springfield, O., & W. P. Allen, Chicago, Ill., 545,070. Filed June 21, 1894.

A system which will permit of operation either by electrical energy or by the motive power transmitted through the means of a moving cable.

Trolley, J. L. Hanson, Omaha, Neb., 545,073. Filed June 4, 1895.

Insulated Support for Trolley Lines, F. X. Olcott, New York, W. J. Belcher, & F. C. Billings, Hartford, Conn., 545.151. Filed April 22, 1895.

Adapted to be assembled in the form of a straight line hanger or in the form of a pull-off, either double or single, for maintaining the alignment of a trolley line.

Electric Railway, J. C. Henry, Westfield, N. J., 545,158 Filed April 20, 1895.

A three wire system employing two generators of different potential and in which the motors are regulated without resistances of any kind.

Trolley Line Clamp, W. J. Belcher, Hartford, Conn., 545,187. Filed April 11, 1895.

Conduit Electric Railway, C. H. Johnson, San Jose, Cal., 545,204. Filed Feb. 23, 1894.

A rail conductor is supported on special insulators on which bears a trolley suspended from the trolley arm of special construction.

Underground Electric Railway, E. E. Moore, Chicago, Ill., 545,208. Filed Nov. 16, 1894

A double conduit placed between the tracks with special arrangement for drainage.

Trolley Controller for Electric Railways, L. W. P. Gray & P. G. Doescher, New Orleans, La., 545,358. Filed May 23, 1895.

Means whereby the trolley-staff or pole upon cars driven by electricity shall be prevented from flying upward in case it should jump from the main conductor; also to provide means whereby the motorman shall be able to control the current passing through the trolley into the car motor.

Guard and Guide for Electric Trolleys, J. R. Tristler, Westwood, O., 545,398. Filed June 1, 1895.

Electrically Operated Mine Car, H. B. Dierdorff, Columbus, Ohio, 545,404. Filed Dec. 24, 1889.

Details of construction.

Telephones:—

Telephone Holder and Cut-Out, A. F. Boardman, Somerville, Mass., 545,191. Filed Jan. 2, 1894.

A telephone switch operated manually by the insertion and withdrawal of the telephone receiver in and from a spring clamp.

Combined Telephone Receiver Support and Switch, G. F. Shaver, Yonkers, N. Y., 545,253. Filed Dec. 6, 1894.

The act of placing the receiver on its support throws a lever which makes the desired connections.

Telephone and Return-Call System, T. R. Brimner, Baltimore, Md., 545,402. Filed Aug. 16, 1894.

The object is to provide for establishing a telephone and return call between the office and rooms of a hotel without change in the wires of the annunciator instrument of those leading from the office to the rooms.

Telephone, G. F. Shaver, Yonkers, N. Y., 545,416. Filed June 8, 1895.

A system in which the connections of the signaling devices are not changed on taking down or putting up the receiver.

LEGAL NOTES.

A RED-HOT ASSOCIATED-UNITED PRESS LITIGATION.

As John R. Walsh of Chicago came ashore from the Teutonic last week, he was served with a complaint in a suit for $200,000, brought against him by the United Press for betrayal of trust and violation of his fiduciary obligations, while acting as Director and Treasurer of that corporation.

The complaint sets forth among other things that Walsh, while acting as Director and Treasurer, and having full knowledge of the business affairs of The United Press, secretly formed a purpose of despoiling and destroying The United Press for his own personal benefit and that of a rival organization, and how, to that end, he disclosed to Victor F. Lawson and Melville E. Stone, both executive officers of a rival corporation, the business secrets of The United Press, and exhibited to them statements in writing purporting to have been taken from the books of the plaintiff to show the financial condition of the corporation whose trusted Treasurer he, at that time, was, and made to them false and fraudulent representations that The United Press was in a state of panic and bankruptcy.

By these means and by various other misrepresentations and slanders, it is charged, Walsh was able to divert from The United Press, business to the amount of upward of $70,000 a year, included in this being the sums paid by the Chicago *Herald* and the Chicago *Post*, owned by John R. Walsh, and the Illinois *Staats-Zeitung*, controlled by him indirectly, its proprietor being under heavy financial obligations to him, and various other papers indirectly controlled or influenced by him, the details being plainly set forth in the complaint.

Having done this, the complaint declares, he, in February, 1894, demanded payment of a sum of money then owed to him by The United Press, and resigned his positions as Director and Treasurer of that corporation. When the money was promptly and fully paid, and The United Press driven into neither a condition of bankruptcy nor of panic, Walsh sought to withdraw his resignations in order that he might be once more in a position to obtain further information to use in hostility to the interests of The United Press, and for his own personal profit and aggrandizement, and it was not until May 15, 1895, that his final resignation was secured and accepted.

AN INTERESTING LAMP THEFT CASE IN NEW YORK CITY.

Last week, in New York city, Judge Jerome sentenced Thomas Jones, of 329 Stanton street, to six months' imprisonment, and Jeremiah O'Brien, of 402 10th street, and John Tracy, of 213 Lewis street, to four months each in the penitentiary, for endeavoring to steal lamps from the Edison Illuminating Company. It is the custom of the illuminating companies to give to their customers new lamps for those burned out, and on Friday afternoon, August 23, O'Brien and Tracy brought a large box of burned out lamps to the 26th street station of the Edison Company and, stating that they came from the Manhattan Club, asked to have them exchanged. As the Manhattan Club was not a customer of the Edison Company and, moreover, as a large part of the lamps were not Edison lamps, the request was refused. The men took the box to Broadway, where O'Brien was waiting with a truck, and while driving through Fourth avenue and the Bowery the three shied such lamps as were not Edison lamps at venders and passers-by, and in so doing hit one of the Edison employés who had been directed to follow the men. The Edison scouts who had been following them up, thinking that perhaps they would attempt to exchange the lamps at the Edison station in Duane street, notified the Superintendent there and when Tracy and O'Brien arrived they met with a cordial reception. The men there represented that they came from Childs' restaurant in Cortlandt street. The police were notified and arrested Jones who had remained outside the building awaiting developments, together with Tracy and O'Brien who had been detained in the building. One of the latter made a break for liberty, but ran into the arms of a stout employé who had been placed at the door in the event of such emergency.

As this is the first conviction for such an offence, it will be of interest to illuminating companies throughout the country.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

PROSPERITY OF THE BALL & WOOD CO.

THE Ball & Wood Co. of New York, reports that never in the history of its business has it had so many orders on its books as at present. This condition of affairs has compelled it to make not only a large addition to its works in building a new boiler house and re-arranging its steam plant, but also in the purchase of more large tools. Recent orders include engines for Milwaukee, Wis.; Terre Haute, Ind.; McGregor, Ia.; Helena, Mont.; Denver, Col.; Colorado Springs, Col.; New Orleans, La.; Altoona, Pa.; Wilkesbarre, Pa.; Flatbush, N. Y.; besides a large number for the new buildings now going up in New York City.

Both from its Chicago and New York offices, this Company reports some stiffening in prices, and altogether it is confident that the improvement of business will continue.

OKONITE CABLES.

The Okonite factory at Passaic is busy turning out two immense cables for the Metropolitan Telephone Company, to carry wires under the North River. Each of the cables has twenty-four conductors, and is over a mile long. The Okonite Company recently manufactured two similar cables to connect New York with Brooklyn. Another piece of work just finished is a cable three miles long and covered with lead armor, made all in one piece. It was shipped to Lenox, Mass., where it will be laid in a subway.

A BRUSH CONTRACT IN CANADA.

A special dispatch from Trenton, Ont., of Aug. 22, says: The contract for lighting the town for ten years has been awarded to the Brush Electric Company of Cleveland, Ohio, represented by Col. W. S. Rogers. The magnificent water-power, capable of producing 12,000 horse-power, north of town, on which a suitable power-house was constructed last year, will be used for the purpose. Besides an incandescent system of lighting, the company will develop the power by putting in large generators, and distribute the power through the town for manufacturing purposes.

ELECTRIC POWER IN SAN FRANCISCO.

THE San Francisco *Report* says that in that city during the past year over 600 users of power have given up other driving machinery in favor of the electric motor.

NEW ENGLAND NOTES.

SPRINGFIELD, MASS.—The Standard Telephone Company is making negotiations for the establishment of an exchange in this city. The New England branch of the Standard Telephone Company, known as the Eastern Standard Telephone Company, has headquarters in Boston, and is capitalized at $9,000,000.

THE BEACON LAMP CO. met with flattering success with their 11,000 lamps used in the Knights Templars' decorations. Mr. J. R. Masury, electrician of B. F. Keith's new theatre, reported that he used three makes of lamps in his Knights Templars' decorations, two-thirds of them were of the Beacon make, and in their four hour test they lost but one Beacon lamp, and 40 and 200 of the other makes respectively. The conditions under which they were used were very trying, owing to the intense heat due to close grouping of the lamps. The Beacon Lamp Company are justly proud of this result.

GINN & Co., the largest book publishers in New England, have recently decided the question of the isolated electric lighting plant for their new building at Cambridgeport, Mass. They have given up the idea of attaching motors directly to the various presses, and their power equipment will consist of a slow speed engine for the main building, and a direct connected engine and dynamo plant for furnishing about 1,000 incandescent lights. After carefully considering the various types of apparatus on the market, they have placed their order for a direct connected engine and dynamo plant, consisting of a Siemens & Halske slow speed dynamo, and a Woodbury automatic high speed engine. It is their intention to have one of the finest plants in New England.

COLUMBIA, S. C.—A party of leading citizens of Athens, Ga., have been inspecting the electric power transmission in the cotton mills at Columbia, and will now put in at Athens, it is said, an electric mill of 10,000 spindles. The leader of the party was Capt. J. J. C. McMahan.

NEW YORK NOTES.

MR. THURLOW WEED BARNES, of the Standard Telephone Co., is understood to announce that his company proposes to do only long distance work.

ALTOONA, PA.—Mr. E. B. Green, the energetic superintendent of the Edison local company is going in this year for electric heating, and hopes to work up a good load for his new plant.

THE CHESLEY ELECTRIC CO., W. S. Chesley, general manager, &c., 601-5 Newark street, Hoboken, have closed a contract with the American Sugar Refining Co. to rebuild three 30 K. W. Edison dynamos that have been in a fire. Business is quite brisk and the working force has been increased.

BROOKLYN, N. Y.—There has been filed the certificate of incorporation of the Union District Messenger company. The company is a somewhat novel one, and its operation is to be confined to the limits of the Twenty-sixth ward, the residents there to be in charge. It is proposed to construct and operate telegraph lines there. The incorporators are Simon C. Ostrom, Henry Kohlert, Thomas F. Livingston, Emanuel Newman, Joseph K. Clark, Richard J. Kelly and Louis L. Hoop. The new company has a capital of $12,000.

WESTERN NOTES.

ROCHESTER, MINN.—The telephone exchange which has been put in this city by Messrs. F. S. Haines and J. A. Melone is being put in operation.

BARABOO, WIS.—All the stock for the proposed telephone exchange in this city has been floated, and the system will be put in at once. Frank Bell has the contract, and the Standard telephone will be used.

ST. PAUL, MINN.—Articles of incorporation of the American Signal and Power company, of Minneapolis, have been filed. Capital stock, $100,000; limit of indebtedness, $50,000. The business of the corporation will be the furnishing of electrical supplies.

DETROIT, MICH.—The directors of the Harrison Telephone Co. have elected as president, Albert Pack; first vice-president, Charles Flowers; second vice-president, R. A. Brett; third vice-president, C. P. Collins; treasurer, Collins B. Hubbard; secretary, W. L. Holmes.

THE ELECTRIC STORAGE BATTERY CO. has opened a branch office at 309 Dearborn street, Chicago, in charge of Mr. C. W. Woodward, well known in storage battery work. A large number of Chicago plants are now utilizing Chloride accumulators, including those of the Chicago University, Chicago Telephone Co., Western Electric Co., &c. The firm of Pierce & Richardson will be connected with this branch in the capacity of consulting engineers.

COLUMBUS, O.—The Interstate Telegraph and Telephone Company, of Columbus, has been incorporated by P. J. McCaffrey, George S. Thompson, Charles J. Ewin, Thomas Thompson and Matthew A. McGrath. The object is said in the articles of incorporation to be to construct, own and operate telegraph and telephone lines in the states of Ohio, West Virginia and Kentucky, and doing a general telephone business with offices in Columbus, Cincinnati and Bellaire, and having these cities as termini of the main lines. The main lines will pass through the counties of Franklin, Pickaway, Madison, Fayette, Clinton, Warren, Clermont, Hamilton, Licking, Muskingum, Guernsey and Belmont. The capital is $10,000.

FINANCIAL.

HOOSICK FALLS, N. Y.—The financial showing of the Hoosick electric line for the past year has been exceedingly good. The total receipts from July 13, 1894, to July 13, 1895, were $13,026.62. The total number of passengers was 270,888, which does not include children under five years of age.

TROY, N. Y.—The Troy City Railway in the year ending June 30, had gross earnings $454,078, and after paying $101,774 interest on bonds had $105,000 left to pay out in dividends. The operating cost including taxes was only 58 per cent. 8,652,722 passengers were carried by 128 motor cars and 48 horse cars, on 31 miles of track.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.

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ELECTRIFYING ZION:—THE BIG COTTONWOOD POWER TRANSMISSION, SALT LAKE CITY, UTAH.

BY

George Heli Guy

I.

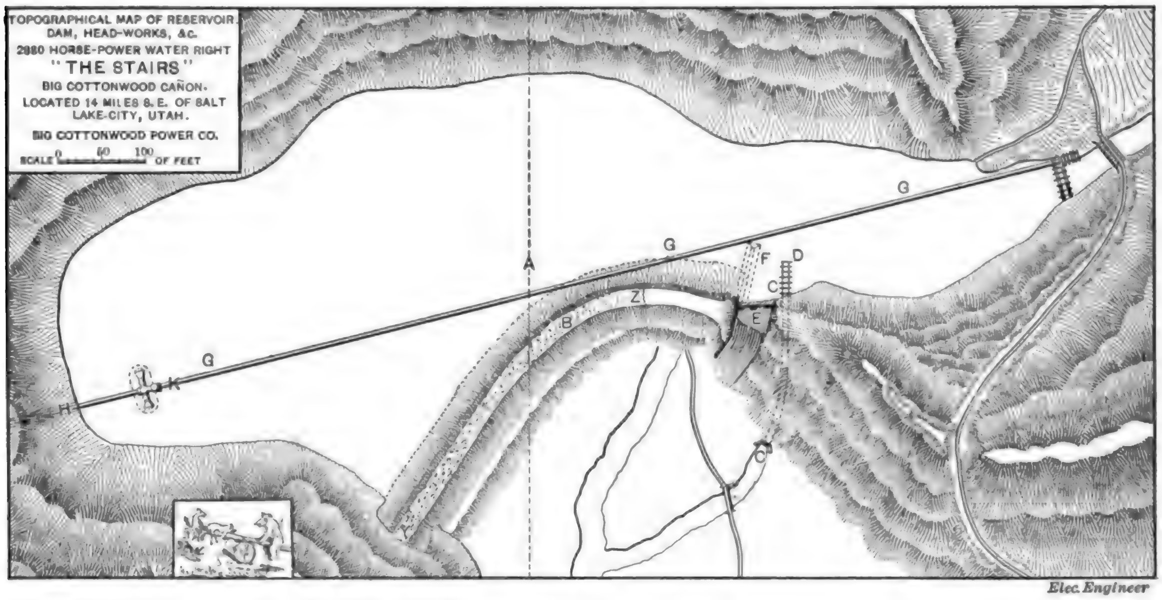
B. M. Jones

A KEEN and travelled observer, who puts the longitudinal limits of his wanderings at Turkey in the East and Utah in the West—from Moslem to Mormon—says a visit to Salt Lake City convinced him that from a sociological standpoint the followers of the Prophet Smith are more interesting as a study than the followers of the Prophet Mahomet. One needs to see the capital of the Church of Jesus Christ of Latter Day Saints, with its great ten-acre blocks, its broad, rectangular streets, its mountain water system, its quaint Mormon walls, temple and tabernacle, to appreciate the marvel of the Mormon exodus of 1846, and the stupendous works of the wondrous chief and builder, Brigham Young. The lever which became such a mighty power in the hands of this great natural leader of men is now discarded, but the work remains. Brigham Young practiced and advocated plural marriages because he wanted his colony to increase. To him it meant fructification and rapid colonization. But polygamy is now dead in Utah, and the people have faced toward a new life. Confident in the strength of its honesty of purpose and its splendid half-century record of privation, patient industry, prosperity, culture and wealth, the great Mormon colony of the West is seeking touch with the rest of mankind, and expanding into wider sympathy with the outside world. Gentiles are now welcomed into the best Mormon social circles. The community on every hand shows signs of vigor and success, socially, politically, and financially. Since the abandonment of polygamy, the membership of the church has increased amazingly, and its missionaries in all corners of the globe tell of the rapid accession of converts that is being brought about by the removal of the primary cause of outside hostility. In the West alone, there are 400,000 communicants of the Church of the Latter Day Saints. The territory of Utah is to be raised to Statehood, and its material wealth is seen in the number and magnitude of its home industries. But its career is only just begun. It has within itself a fund of resources that will bring it into a leading place among the forces of the age, and it is to the development of these agencies that it is now bending itself. The sublime Wahsatch range, under the shadow of which Salt Lake City springs out of the plain, is studded thickly with water streams, caves, and pockets, fed by the springs and drainage of the mountain, the overflow from which has always been utilized by the Mormons for the fertilization of their valley farms. The grandeur and beauty of its peaks and lakes are unequalled even in the Bernese Alps, and the picture of Lake Blanche, with its setting of snow-mantled cliff, shown on this page, will suggest to the traveller in Central Europe the rugged and awful profile of the Matterhorn. This and seven other of the Wahsatch lakes, lying still, dark, and solemn, at altitudes of 11,000 to 13,000 feet, are now to be the means of filling the valley below with light and gladness. In the picturesque Big Cottonwood Canon, where the granite blocks for the ponderous and imposing Mormon temple were quarried, these waters are being dammed, and converted into a power that will develop the resources of Utah in mines, products, and manufactures, to an extent almost unparalleled in the history of the West. The Big Cottonwood Power Company has practically completed its plans for the generation and transmission of electric power from the various water supplies in the Big Cottonwood Canon, thirteen miles south-east of Salt Lake City, for the supply of light and power within the limits of the city, and to the factories and small towns in the vicinity.

LAKE BLANCHE: ONE OF THE FEEDERS OF THE BIG COTTONWOOD WATER POWER.

II.

The power station is located in the Cañon, at "The Stairs," 14 miles by pole line from the distributing station of the Salt Lake & Ogden Gas and Electric Light Company, in Salt Lake City. At this station, there is a minimum flow of 3,400 cubic feet of water per minute, which,



TOPOGRAPHICAL MAP OF RESERVOIR, DAM, HEAD-WORKS, ETC., "THE STAIRS," BIG COTTONWOOD POWER CO.

working under 380 feet head, produces 2,447 H. P. any and every hour in the year. During nine months of each year, it will give nearly 4,000 H. P. The storage reservoir at the head of "The Stairs," has an available capacity of 24 hours' continuous flow of the stream, making all of the water available by using an excess during maximum loads and allowing the reservoir to accumulate during minimum loads. 58,800 H. P. hours per day of 24 hours, is looked for from this source, of which 68 per cent. can be delivered in Salt Lake City in contract form, making 40,000 H. P. hours net daily. The 68 per cent. efficiency is derived from: Pelton water wheels 80 per cent., G. E. generators, 94 per cent., G. E. transformers (raising) 97½ per cent., line transmission 95 per cent., G. E. transformers (reducing) 97½ per cent., or a total of 68½ per cent. The map of the reservoir shows a pipe line extending from the head gates, submerged in the bottom of the reservoir, to a penstock or receiver wood housing with "grizzlies" located just below the bridge. This pipe, of steel-banded redwood, is anchored to the bottom by rock piles, and is to be used in the event of its being necessary to drain the reservoir, without interfering with the running of the station. This is accomplished by closing the head-gate valves, and opening the reservoir valves in the drainage tunnel, and the station will thus be supplied from the natural flow of the stream, during such time as the reservoir might be empty.

III.

The outside dimensions of the generating station are 34 feet by 100 feet. The generating plant consists of four 450 K. W. three-phase General Electric generators, separately excited, non-compounded, set with armatures, parallel to each other, facing up in true line in the building as shown in plan and elevation on page 248. Each generator is driven by one heavy special Pelton wheel, 60 inches in diameter, provided with two nozzles 3¼ inch diameter. The straight nozzles are provided with a gate valve for shutting off, and the lower nozzle is equipped with a hood regulator, so that both good regulation and economical use of water are secured. Each nozzle at 370 feet effective head, produces 310 mechanical H. P., and runs at 300 revolutions per minute, its economical speed. The water wheel is keyed directly on the armature shaft, in lieu of a pulley. In addition to the generators named, four 12½ K. W. exciters, made up in two sets, will be used; both generators of each set being connected together by friction couplings, and each generator to be driven by a 14-inch Pelton wheel, with cast housings. Each set will consist of two generators, and two wheels will be built up on a cast-iron base-plate, making a rigid and direct connection. This application provides exciting energy in two units, and at all times either one or two exciters are in reserve. The exciters are to be run in multiple, and all connected to one common "bus line" on the switch-board. The three-phase generators will also be operated in parallel. There will be six raising transformers, 265 K. W. each.

IV.

The poles for the line construction were selected from live growth of Sand Point (Idaho) cedar. The smallest are 40 feet long, and 8 inches in diameter at the top. They are placed 100 feet apart. The line conductors consist of 12 wires, four circuits of three wires each; all No. 2, soft-drawn bare copper, and connected to the same common "bus line," at the generating and at the distributing station. The line loss, in delivering 1,520 kilowatts at 10,000 volts, will be something less than 5 per cent.

The transmission line from generating to distributing station is 14 miles by pole line. The distributing station is owned by the Salt Lake & Ogden Gas & Electric Light Company, who rent it to the Big Cottonwood Power Company at a nominal rent. It contains, for "step-down" transformation, nine 175 K. W. air blast transformers, from the secondary side of which the Electric Light Co. buys the current wholesale by meter. This arrangement is a most convenient one for both companies. The actual terms of the contract are that the electric light company is to be supplied with all the current it can dispose of for electric lighting and power, in units of 10 H. P., and under, the Big Cottonwood Company reserving the right to supply power to motors in units exceeding 10 H. P., and the right to reach such wholesale users of power by wires erected on the electric light company's poles, throughout all the districts within the city limits. The contract begins January 1, 1896, and runs for a term of five years. Its conditions are that the current is bought at 2,000 volts, three-phase, at a stipulated price per K. W. hour, which will be used to supply electric light and power for any purpose up to 10 H. P., and for elevator service up to any limit desired by the lessees. 2,000,000 units annually is the minimum limit of the consumption of current.

The present production of the electric light company is practically 3,000,000 units per annum by the use of coal after the usual central station methods, and the contract provides that as soon as the transmission power plant is

in operation, the steam plant of the electric light company is to be abandoned, the price to customers reduced, and other changes made that will be to the advantage not only of both companies but also to that of the public, by promoting the production of cheap electric power.

V.

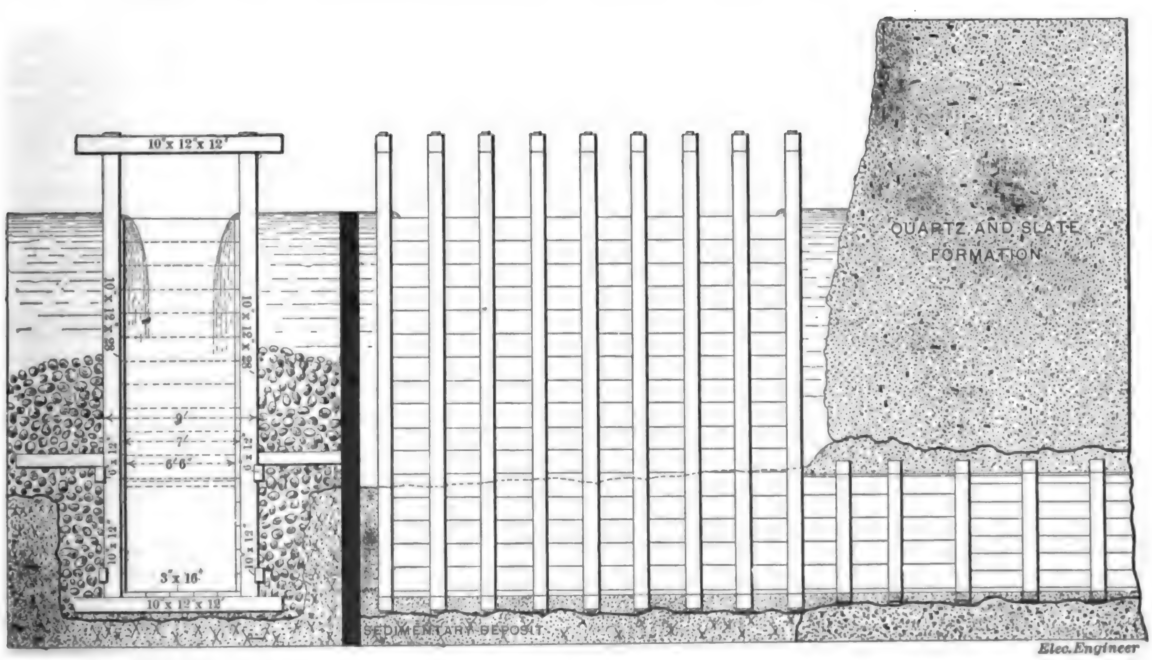
The final cost of the complete development is estimated at $300,000. An estimate of $300,000 for the original outlay for "The Stairs," would give for construction expenses—at 2,258 H. P.—$132.72 per net H. P. delivered in the city ready for use. The future of the company seems to be well assured. The company's affairs have been so well administered that much more than half the power to be developed has already been disposed of absolutely, and the guaranteed total revenue from completed contracts is over $100,000 annually. Although the company is confining its operations for the present to "The Stairs" supply, it has other valuable water rights partly developed by means of which it could at any time largely supplement its output.

VI.

It is worth while here to review briefly the natural advantages of Salt Lake City, which must be borne in mind if anything like an adequate idea of the importance and far-reaching effects of this great semi-Mormon enterprise is to be arrived at. Cheap electrical power will open up possibilities for electro-chemical work, such as the manufacture of aluminum. The district has bauxite in abundance, and in this industry power is all-important, and freight is hardly considered. For the manufacture of salt products, bleaching powder, disinfectants, soda, sodium, calcium carbide, &c., all the raw materials are on the ground, and cheap power only is needed. The electro-deposition of copper will certainly grow into a huge industry, for the extensive leads of copper ores are as yet undeveloped. A large copper smelting plant is now about ready to start. The electro-deposition of gold and silver is also a coming industry which will rapidly expand when cheap current increases the economy of the process. These are classes of work depending for their successful prosecution almost entirely on power, and requiring materials mined or found in the Salt Lake country in enormous abundance. In mills and factories the ordinary industrial operations likely to be created by cheap power are wool scouring, paper making, the manufacture of cotton fabrics and the making of flour. With the increase in these factories there will be a call for better facilities for iron workers and engineering work, which will require further power. There will be a prompt and large demand for current for electric transit. Cheap power will enable trolley lines to be pushed out all over the Salt Lake Valley, to be used for bringing farm produce into the city and ores to the smelters. With these improved facilities for transportation, the farming industry of the Salt Lake Valley will increase enormously, and a large fruit trade will be established. Two electric roads are already operating successfully; the Salt Lake City Railroad, with about 70 miles of track, and 45 cars, and the Rapid Transit Company, with about 28 miles of road and 24 cars. These roads already stretch out from 5 to 10 miles from the centre of the city. The output of gold and silver ore with lead bases is infinitely larger than statistics show, owing to the fact that enormous quantities of ore are shipped to Colorado smelters. Before long these ores will be smelted in Utah by electrical processes. The headquarters of the large mines, such as the Ontario, Centennial Eureka, Mammoth, Anchor, Crescent, Silver King, and the various mines in Park City, Tieutic, Bingham and Mercur, are all located in Salt Lake City. The first successful practical application of the cyanide process for extracting gold ores was made at the Mercur mines, located within 10 miles of the city. There are four large smelters and five sampling works. These smelters and the mines require large quantities of power continuously through the year, and though the application of electricity to mining is somewhat slow, it will surely become general. The Ontario mine has taken the lead by putting in a small monocyclic light and power plant, utilizing the waters from the great drain tunnel.

VII.

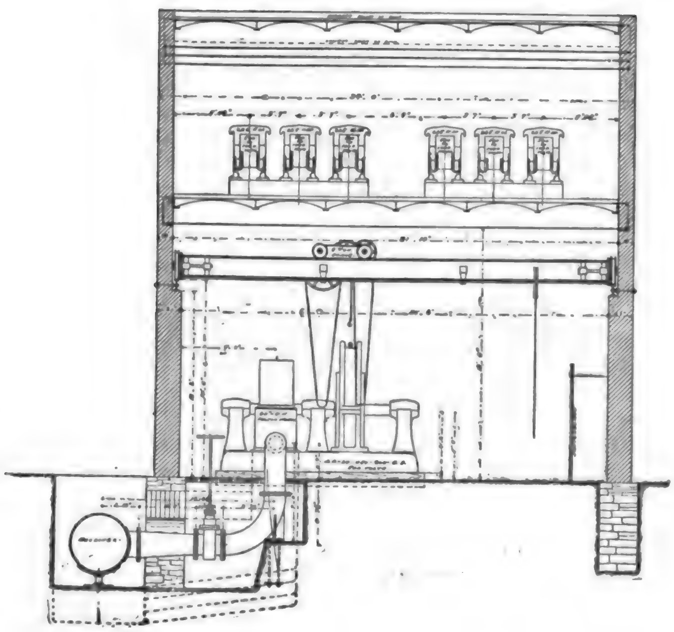
This is only a partial list of the commercial possibilities which will be opened up by the new conditions. But the Big Cottonwood transmission is remarkable not only for the immense development of which it will be the incentive, but as affording at its distributing station, an instructive illustration of supreme ingenuity in grafting new methods on to old appliances, and in combining the best points of more or less antiquated, and of modern practice in a harmonious and highly effective system of electrical distribution. It is fortunate that this critical work has fallen into such hands as those of R. F. Hayward, the able general manager of the Salt Lake & Ogden Gas & Electric Light



OVERFLOW HEADGATE AND TUNNEL FLUME, AT "THE STAIRS," BIG COTTONWOOD POWER CO.

Company, whose deservedly high reputation as an electrical engineer extends far beyond the limits of the State in which he has so successfully labored and into foreign countries.

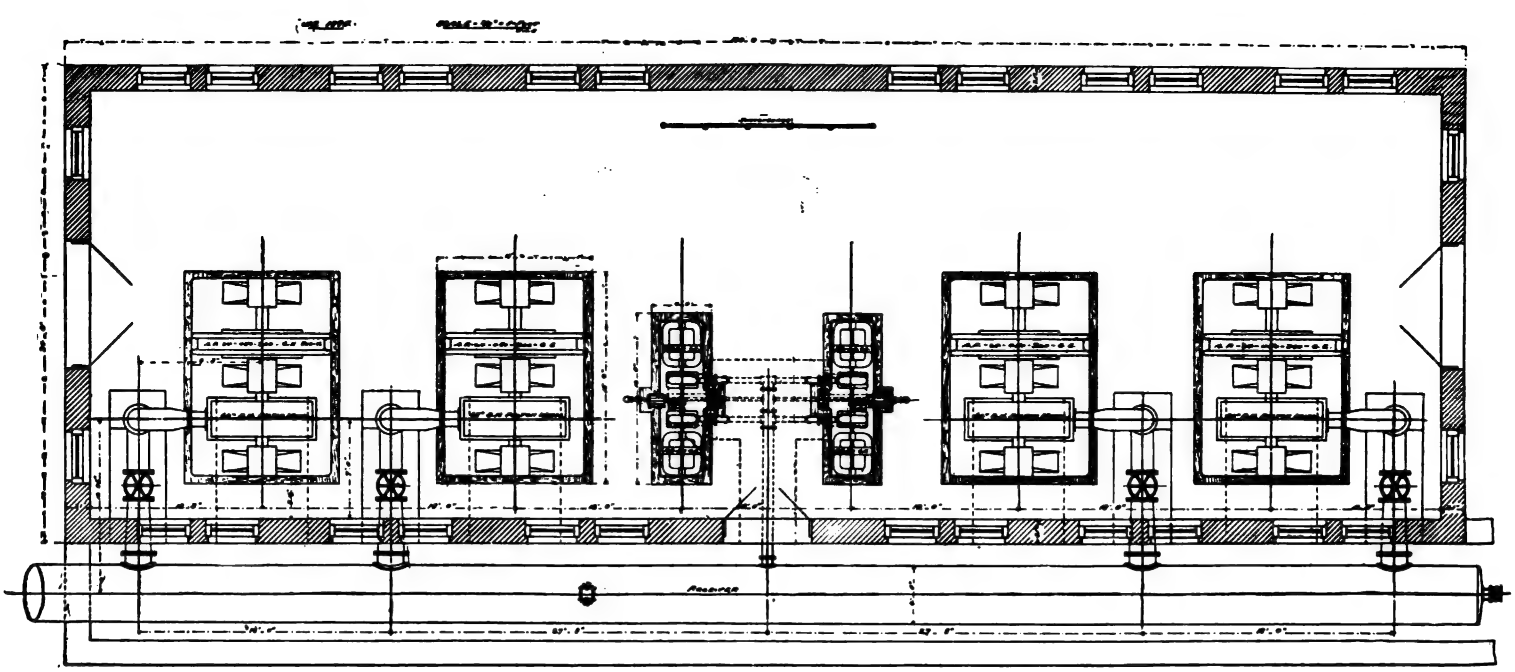
The new system, when complete, will consist of a net-



POWER HOUSE OF THE BIG COTTONWOOD POWER CO.—TRANSVERSE SECTION.

work of primary mains with a network of low tension secondaries, wherever the houses are in close proximity to each other. The primary mains will be at 2,000 volts. They will run along every street east and west and will have equalizing cross mains on several streets running plated. The transformers will be placed at street intersections in banks either fixed on the poles or in any suitable location near the intersection. In the commercial districts there will be a bank of transformers at every street intersection; but in the incidental districts one bank will be placed at every other intersection, the blocks being 792 feet square. Arrangements will be made for switching out alternate banks of transformers during light loads to save the waste of energy. To do this both the primaries and secondaries of the transformers will have to be controlled. The feeders will be brought from a distributing station situated near the centre of the town. The current will be supplied from the generators of the Big Cottonwood Power Company's station on the three-phase system. The feeders and primary mains will therefore consist of three wires each of the same size. The secondary mains will consist of three wires and a neutral wire. The voltage between any one of the three wires and the neutral will be 115, and this will be the voltage of the lamps. Motors, synchronous or non-synchronous, can be connected at any point to the secondary mains, or, when the motor is large, separate transformers will be used. It is intended to eventually use the alternating current for all arc lamps, in which case they will be connected to the secondary mains with small transformers. For street lighting it will be necessary to make special arrangements for switching the lamps on and off. At present there is a mixture of all kinds of systems in the station, but when the new system is complete, instead of the multitude of heterogeneous wires and circuits now existing, there will be three 2,000 volt primary wires and four secondaries on each street running east and west, and only four secondaries on streets running north and south.

The distributing station will be a substantial fireproof building, with a room for the 10,000 volt step-down transformers, a room for the 2,000 volt switchboard, and a room fitted up with instruments for testing and calibrating meters, etc. The current will be brought from the step-



POWER HOUSE OF THE BIG COTTONWOOD POWER CO.—PLAN.

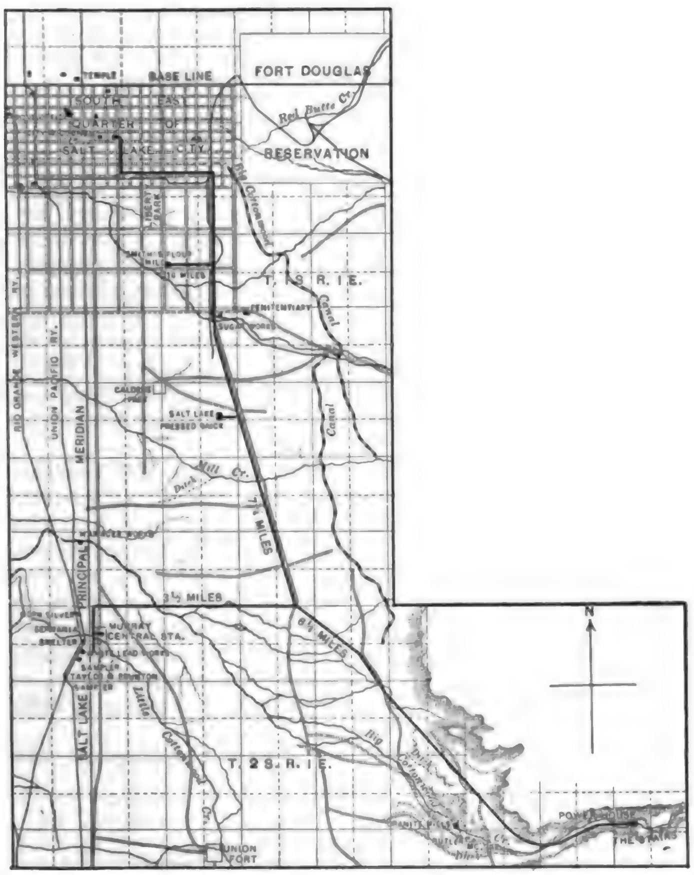
north and south. There will eventually be ten feeding points, though at first only six will be required. The secondary mains will be used almost entirely; only when the houses are very scattered will separate house transformers be used. In the commercial district, the secondary and primary mains will eventually be put underground, though this is not immediately contem-

down transformer to the distributing board. On the first panel will be a three-phase Thomson wattmeter for recording the energy received; also three amperemeters, one in each leg of the system, to show the balance; also, a station voltmeter to show the volts on the secondary wires at the feeder points, for which purpose, pilot wires will be put up. From the ammeter the current will pass along three

bus bars to the several three pole switches, from whence it will pass through fuses to the feeders. The feeder switches are designed for 100 K. W. each. Only ten feeders will be at first arranged for, though more will be added as they are required.

The distributing system and feeders have been designed of ample capacity for a very small drop, and with the complete system of primary and secondary mains the regulation will be very perfect. By cutting out transformers during times of light load, it is expected to obtain a very high distribution efficiency.

The change from the old to the new system will be no easy matter, and will have to be done gradually. In order to take the initial steps immediately three 150 kilowatt three-phase alternators (General Electric) will be driven by the existing steam engines, and will supply energy in the commercial district until the Cottonwood plant is



Map Showing Location of Power Line.

ready. When the Cottonwood supply is established, these generators will be used as synchronous motors to drive the arc lighting machinery, and when the direct current arc lamps are replaced by alternate current lamps the machines will be available for use as motors whenever required. It is contemplated to use presently the old single-phase alternators as motors. In this way much of the old plant can still be utilized.

VIII.

The Big Cottonwood is thus to take its place among the great power transmissions of the country. With it will always be inseparably connected the name of Robert M. Jones, who planned the scheme and piloted it to success with characteristic skill and tenacity. Mr. Jones is a distinct figure in the history of electrical work in the West. He was born in Ashtabula Co., Ohio, in 1853. In 1870 he joined a camp engaged in government surveys in Indian territory. After two years he obtained the position of U. S. Deputy Surveyor, and in that capacity was closely identified with civil and mining engineering through New Mexico, Arizona, Colorado, Wyoming and Utah, until 1884, as he describes it: "A dismal siege of fourteen years; most of the time in advance of civilization, soap and railroads." During this period at intervals he had the supervision and handling of mining and milling machinery, and held the post of Master Mechanic of the Quartermaster's Department, of the District of New Mexico and Arizona for two winters. In 1880 he brought out a "solar transit," combining the meridian-giving qualities of the Burt solar compass, with the accuracy of the engineer's transit. Up to 1885 the electrical industry in the Intermountain region was confined to telegraph and limited telephone work. In electric lighting there were only three small Brush stations, at Denver, Cheyenne and Salt Lake City, respectively. Mr. Jones took a prominent part in the organization of the Laramie (Wyoming) Electric Light Company, conducting the business as secretary and manager, and planning and superintending the mechanical construction of the station, which was equipped with Edison apparatus. At this time the Laramie station was rated the seventh as to capacity in the United States, and for three years of Mr. Jones's management it was the second as to dividends. Mr. Jones was the first to recognize the value of the Sprague direct current motor for Western work, and he installed three of the first motors made—25 H. P.—for driving a 100 barrel capacity flour mill in Laramie. The installation worked without a hitch. It was at the time noted in the East as a matter for surprise that the very earliest applications of electrical transmission of power could be made in such an out-of-the-way country as Wyoming. In May, 1889, Mr. Jones began the construction, under private contract, of the electrical equipment of the Salt Lake City Railway with Sprague apparatus, and he has since been associated with practically all the important electrical installations in Utah and Wyoming. In point of fact, he holds a record of over 90 per cent. of the entire electrical work done in those territories. Since 1886 Mr. Jones has been actively engaged in the engineering development of the Big Cottonwood transmission which is now regarded as the third installation in the country in point of the power developed and the importance of its commercial bearing.

WHAT HINDERS TRANSMISSION AT 50,000 VOLTS?

BY EDW. P. BURCH,

Electrical Engineer, Twin City Rapid Transit Co.

In The Electrical Engineer of Aug. 21, p. 186, I note in a description of the line to be used in the transmission near Fresno, Cal., of some 7,000 H. P. at 11,000 volts, the writer states that "thirty miles of the route are through an open level country under ideal conditions of transmission."

In one of our stations we often use two 100-light arc machines in series and have in regular service an "Excelsior" dynamo, which supplies current to 151, T.-H., 10.5 ampere, 50 volt lamps, on a 21 mile circuit, most of the lamps being at shops and at a lake six miles from the machine. The circuit runs through the city, and then along boulevards where hundreds of trees rub against the K. K. wire which has been in service five years. Green glass insulators and common 30 foot poles are used.

The line insulation during the past year has averaged one million ohms to ground, and almost as high between legs. The minimum insulation after long soaking rains seldom goes to 100,000 ohms between legs or to ground, and during some very wet weather often remains as high as one million ohms. The leakage is distributed and we have no trouble; the machines run for months without "slopping over;" 7,000 volts potential between legs is common, and this during wet weather,—we often run higher. Had we men to keep our circuits always clean,

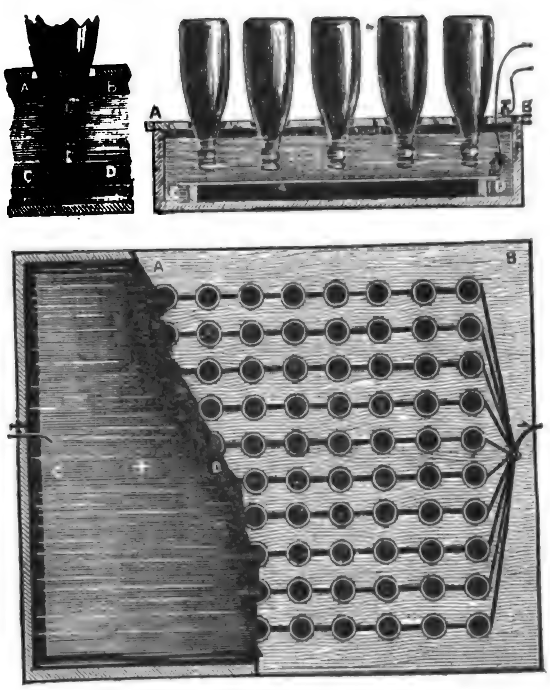
with good insulators and no trees, it seems as if we could easily stay at ten million ohms insulation resistance (which is what we now average during the winter).

The point I am coming to is, what is hindering power transmission engineers from using, say, 50,000 volts pressure. If transformers are in series the strain is distributed and danger to life and apparatus is small. The line will certainly be all right. Who will state why higher potentials are not used when general economy calls for it?

MINNEAPOLIS, MINN.

SEALING CHAMPAGNE BOTTLES ELECTRICALLY.

In a recent number of *La Nature*, Mr. A. M. Villon describes a novel method of sealing champagne bottles. The loss and deterioration of champagne due to the escape of gas has long made some process of perfect air-tight sealing desirable. M. Villon accomplishes this by covering the cork and a part of the neck with a thin layer of copper electrically deposited. For this purpose the neck of the bottle is covered with a conducting substance such as black lead, zinc or copper powder, and plunged in a galvanic bath, as shown in the accompanying illustration.



SEALING CHAMPAGNE BOTTLES ELECTRICALLY.

This bath has a cover of paraffine wood, A B, with conical holes, which are lined with copper rings. All these rings are connected among themselves, and with the negative pole of the dynamo; while a copper sheet in the bath is connected to the positive pole. The bottles are simply inserted in the holes, neck down, and when a layer of $\frac{2}{10}$ to $\frac{3}{10}$ of a millimetre has been deposited the current is stopped. The deposit may be gilt, silvered or given any desired shade in special baths. The process of course can be employed to seal bottles for mineral waters, preserves and a variety of products.

ABDANK'S HYSTERESIS COMPENSATOR.

The researches of Ewing, Hopkinson and others have shown how greatly the action of iron depends upon its previous magnetic history, and hence when iron masses are employed in electrical indicating and other apparatus these effects of residual magnetism, coming under the more general class of hysteresis phenomena, introduce errors. As a result, indicating instruments of this type have been shunned in the past where accuracy was considered desirable. The simplicity and cheapness of this type of instruments has nevertheless given them considerable vogue, and the most recent attempt to remove the cause of objection to their use will therefore be of interest.

M. B. Abdank-Abakanowicz, of Paris, well known to many American electricians, has just devised what he calls

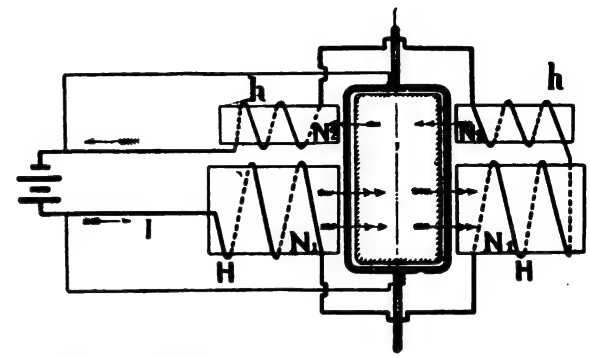
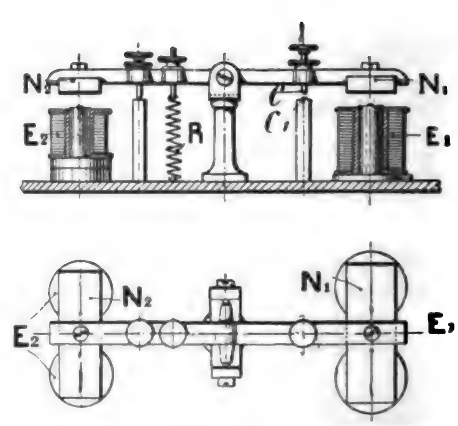


FIG. 1.—ABDANK'S HYSTERESIS COMPENSATOR.

a hysteresis-compensator, to effect the desired purpose. This he accomplishes by combining with a magnetic circuit one or more masses of iron or steel, constituting what he calls a "secondary differential magnetic circuit," the action of the lines of force of the secondary circuit being opposed to those of the principal circuit. By properly choosing the dimensions of the secondary, with reference to those of the principal magnetic circuit, a differential value may be obtained for all currents within the range of the apparatus, which will be proportional to those currents. In other words, the effect of the residual magnetism of the first circuit is neutralized by the residual magnetism of the second.

The accompanying diagram Fig. 1 shows the application of these principles to a continuous current wattmeter. The potential is measured by the movable coil and the current is made to traverse the coils H, of the principal electromagnet and the coils *h* of the secondary or compensating electromagnet. The core N′, which produces the principal flux, is made of metal having the smallest amount of hysteresis possible, of soft iron, for instance, while N², which produces the flux for compensation, is made of cast iron or steel, or some metal having a high coefficient of hysteresis.

The double arrows in the diagram represent the



FIGS. 2 AND 3.—ABDANK'S HYSTERESIS COMPENSATOR.

directions of the magnetic fluxes and the single arrows those of the current. By varying the sections of the two cores N′ N² the ampere-turns applied to these cores and the air-spaces of the magnetic circuits, it is possible to make a combination such that the residual magnetism is either entirely or only in part compensated, and that the

resultant magnetic flux will be always proportional to the current, in which case the resultant torque of the armature will be proportional to the watts. Practically the same method may be applied to the case of a solenoid acting on a core of soft iron, which core it is desired shall be drawn in by the action of the solenoid to a certain predetermined point when the current shall have attained a certain predetermined value.

Figs. 2 and 3 show the same principle applied to a relay. The principal electromagnet E′ acts on the soft iron armature N′ in opposition to the spring R and against the action of the differential electromagnet E² and the armature N², which have a high coefficient of hysteresis. The two electromagnets are supposed to be excited by the same current. By choosing suitably the elements of the magnetic circuits of the two electromagnets it is easy to arrive at such a combination as will insure that the contact between *c c′* will always just take place when the current has attained a certain predetermined value, whatever may have been the previous values of the current. The practical rule to follow in this case is as follows: The attraction due to the residual magnetism of the electromagnet E² and of the armature N² ought to be equal to the attraction produced by the residual magnetism of the electromagnet E′ and of the armature N′ for the position of contact.

ELECTRIC TRANSPORTATION DEPARTMENT.

OPERATING ELECTRIC AND STEAM ROADS ON THE SAME TRACK, LOUISVILLE, KY.

The accompanying engravings show views taken from photographs on the railway of the Kentucky & Indiana Bridge Co., extending between Louisville, Ky., and New Albany, Ind., over the cantilever bridge across the Ohio River. This railway is of peculiar interest, as it is the only one in the world, so far as our information extends, over which steam and electric trains are regularly operated on the same tracks. In view of the increasing tendency toward the use of electric motors for suburban passenger service, and the desire to retain steam locomotives in use for freight service and perhaps for heavy express service on the same lines, the experience upon this short line of railway is of especial interest.

In an interesting letter appearing in our excellent contemporary, *The Engineering News*, Mr. Geo. MacLeod, superintendent of the Kentucky & Indiana Bridge Co., describes the salient features of this road as follows:

Prior to August 25, 1893, the Kentucky & Indiana Bridge Co. operated its suburban line between Louisville, Ky., and New Albany, Ind., by steam; but on the above date an electric system was installed, and since then a 15-minute service between the two cities has been in operation. This change in motive power was made because it was decided that by substituting electricity for steam, a more frequent service with a correspondingly increasing travel could be had at a lower cost per passenger mile. The suburban trains when operated by steam were run every 30 minutes, instead of every 15 minutes, as at present.

The Kentucky & Indiana Bridge Co.'s tracks extend from First St. in Louisville to Vincennes St. in New Albany, a distance of 4.11 miles, crossing the Ohio River on its own bridge, which is located at the foot of 32d St., Louisville. The bridge, with the approaches, is a mile in length; the bridge proper, in design a cantilever, is 2,435 ft. long, having seven spans, the longest being 483 ft. The draw span over the Indiana channel has a length of 370 ft. The bridge, a view of which is shown in Fig. 3, carries a single track railway and double highways, one on each side of the railroad.

Besides the above-mentioned tracks, this company controls and operates the Louisville Belt Line and the New Albany Belt & Terminal Railway, and runs its electric cars in connection with the New Albany Railway, an electric street railway whose cars connect at Vincennes St., New Albany, with the suburban trains of the Kentucky & Indiana Bridge Co. Of the 4.11 miles of track used by the suburban trains, 2.11 is double track, the remainder is single track, consisting of the bridge and its approaches, and an iron viaduct between Eleventh and First Sts., Louisville.

The electric trains use the bridge and the tracks above described, in common with the freight and passenger trains of the Baltimore & Ohio Southwestern Railway and the Southern Railway Co. (which roads use bridge and belt lines) and the switch engines of the bridge company, which latter are used in the transfer of freight between the industrial works, factories and warehouses on the bridge and belt tracks, and on the different railways entering Louisville and New Albany. There is an average of 270 trains run over this 4.11 miles of main track daily, of which number 141 are electric trains and 129 are steam trains and engines. The road is operated under the block system; there are ten stations on the line and the schedule time of the electric trains, including the ten stops, for the 4.11 miles is 17 minutes.

FIG. 1.—ELECTRIC AND STEAM TRAINS ON KENTUCKY & INDIANA BRIDGE CO.'S RAILWAY.

The cars are 28 ft. long, inside measurement; and the motor cars are vestibuled, with trolley-stand and brake at each end, and equipped with General Electric Co.'s W. P. 50-H. P. motors. The overhead trolley wire of No. 0 copper wire is carried upon span wires; the poles are of white cedar, 30 ft. long, and spaced every 125 ft. along the line. On the viaduct and approaches to the bridge the line is supported by arches, formed by 3-in. pipe, trussed on posts and top. The hangers on the bridge proper are of the ordinary barn type, fastened to the struts by wooden blocks. The No. 0000 stranded feeder wires are carried on the same poles with the span wires; they are carried over the top of the drawspan of

the bridge, being supported at only one point, the centre of the span, on a pivoted arm.

These electric trains have now been in operation two years.

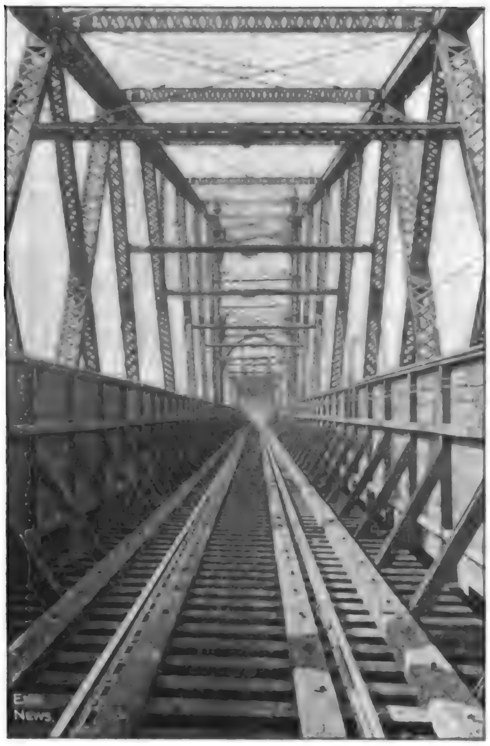


FIG. 3.—ELECTRIC AND STEAM RAILWAY BRIDGE OVER THE OHIO RIVER, LOUISVILLE, KENTUCKY.

We have never had any accident, with the exception of one derailment, which was occasioned by a misplaced switch. The electric trains are preceded and followed by steam trains. The time allowance between trains is two minutes.

Fig. 1 is a view showing an electric train passing a switch engine with a cut of cars, near 24th street, Louisville, Kentucky. Fig. 2 is a view of the Seventh street Union Depot, showing an electric train on the main track and steam trains in the shed.

Our experience for the past two years with the electric service proves to our satisfaction that the safest, cleanest, speediest and most economical method of handling suburban passenger traffic on steam railways is by trolley cars operating on the same tracks with steam trains of all classes, and that this can be done successfully without danger to the trolley cars, or detention to or interference in any way with the steam service.

FIG. 2.—ELECTRIC AND STEAM RAILWAY DEPOT, LOUISVILLE, KY

REPORT OF THE PROVIDENCE, R. I., CAR FENDER COMMISSION.

The following important report has been submitted by the Fender Commission to the Providence City Council :—

The commission appointed by resolution No. 845, approved July 10, 1895, to inquire into and report to the Council at the earliest practicable date what in their opinion is the most desirable safety fender or life guard to be placed upon the street railway cars of this city, respectfully beg leave to submit herewith a partial report.

That your commission organized on July 12, two days after its appointment, and immediately proceeded to inquire into the action taken in other cities respecting car fenders. Having examined the reports of the various commissions appointed in Baltimore, New York, Brooklyn and Philadelphia, your commission proceeded to examine into the merits of various patented and other devices, some with and some without working models, that were exhibited before them by various persons. Of these contrivances only four were regarded with favor by your commission. These were the fenders invented or owned by Arthur H. Jelly, and the Consolidated Fender Company. But your commission do not consider that these fenders are perfect. No fender should be adopted without a wheel guard, which, in the opinion of the commission, should extend entirely around the car.

Your commission are convinced that the most successful device for saving life on street railways is a light projecting fender which shall readily pass over, without injuring, the human form which it may fail to trip and catch, or which may be already prostrate; and which is supplemented by a wheel guard close as possible to the wheel to be brought into action automatically rather than by the foot of the motorman, and provided with powerful springs to bring the guard into contact with the rail and street surface.

Without a wheel guard such as has been suggested by your commission, either the Jelly automatic or the Consolidated fender may be advantageously used, but it is the opinion of your commission that there is not any fender that is always sure to save life. A good, intelligent motorman is the best preventive of accidents on street railways, and to that fact perhaps is largely due the immunity we have had in Providence from frequent accidents during the three years the electric cars have been in operation.

The managers of the railroad company have afforded the commission every assistance in the consideration of this subject, and have provided cars at all times upon which to test the various fenders submitted for trial. They have agreed to equip their cars with suitable wheel guards and with one of the fenders selected by your commission just as rapidly as it is possible to build them.

Your commission therefore submit the accompanying resolution approving the Jelly and Consolidated fenders, and unanimously recommended its passage.

FRANK F. OLNEY, Mayor and Chairman; ROBERT E. SMITH, Commissioner of Public Works; GEORGE L. VOSE, Chairman of the Committee on Railroads.

Accompanying the report was the following resolution :

Resolved, That the City Council, in accordance with the provisions of Clause X of Section 1 of Chapter 667 of the city ordinances, approved July 18, 1895, does hereby approve as a desirable safety fender or life guard, either of the rescue or safety appliances known as the Jelly Automatic Fender, or the fender

of the Consolidated Car Fender Company, provided the same is used in connection with a suitable wheel guard, and approved by the commission appointed by resolution No. 845, approved July 10, 1895.

The resolution was passed.

POWER CONSUMED BY BRUSHES IN RAILWAY MOTORS.

BY JNO. C. HENRY.

SEVERAL months ago THE ELECTRICAL ENGINEER published a contribution of mine relating to the losses in electrical machines, more particularly in railway motors, and also published a description of my magnetic brushholder, which was designed to avoid much of the wear of commutators and brushes, and at the same time to increase the motor's efficiency by decreasing the losses caused by the heavy pressure of the brushes against the commutators. I reported that in some of the old style, double reduction motors I found the practice was to use a brush pressure of about twelve pounds. This, at a car speed of twenty miles per hour, called for work equivalent to over 200,000 foot pounds per minute.

At the time of writing, the actual mechanical loss was unknown, as no data was available showing the co-efficient of friction between radial carbon blocks and the commutators. Since then we feel greatly indebted to Messrs. Cox and Buck of Columbia College whose paper published in THE ELECTRICAL ENGINEER of August 7 clears this matter up. Fig. 7 of the article referred to, shows that with radial carbon brushes the tangential pull is about the same as the brush pressure. From this data it must be evident the loss in the case I referred to was over six-horse power, from the friction of the brushes alone. Since then I have measured the pressure used on some of the more modern, single reduction machines, one class of which used eight pounds, another ten pounds. With the latter, at a speed of fifteen miles per hour, which was about the average speed of the cars, the loss appears to be about two mechanical horse power. It is quite possible that my investigations have been confined to extreme cases; but on the other hand it should be remembered that Messrs. Cox and Buck were dealing with smooth commutators, such as the railroad companies do not always use. Quite recently Messrs. Houston and Kennelly, whom we regard as excellent authority on dynamo electric machines, in their technical papers referred to the loss from brush pressure, giving the impression that the percentage could only be expressed in decimals, and that it was small and might be neglected. While this is doubtless true with large dynamos, it is incorrect as to railway motors.

Subsequent investigations may change my views, but at the present writing I am of the opinion that there is a chance to increase the efficiency of railway motors from five to ten per cent. In considering this subject it should be borne in mind that all causes in electric machines which tend to lower their electrical efficiency are of a destructive character. In the case herein referred to the brushes and commutators are being destroyed.

FAVORING THE CONDUIT TROLLEY FOR NEW YORK.

Ex-State Senator George W. Plunkitt has given much thought to the underground trolley system. He says: "I am so convinced of the excellence of the underground trolley that I have made an offer to the Eighth avenue company to put it into successful operation on half a mile of the line at Macomb's Dam. I to stand all the expenses, &c., and to foot all the loss if the system should not prove satisfactory in every way. I hope by October to have the matter settled. I want to get to work before the frost gets into the ground."

FINDING FAULT WITH THE BALTIMORE LOCOMOTIVE.

S. B. Caswell, an expert mechanical engineer of Indianapolis, Ind., has just returned from the East, where he gave a good deal of attention to the matter of substituting electric motors for steam locomotives. As a result of his investigation Mr. Caswell said: "The work of the motors is, so far, very unsatisfactory, and it is doubtful whether they will be used any great length of time. So far they have been a constant source of trouble and expense, owing to the defect in the overhead trolley system, which it is difficult to remedy. A peculiarity of the electric motor lies in the fact that its tendency is to start its load with a sudden jerk. There is no gradual acceleration of speed, but a bound forward as if the impulse were the result of an explosion. Such a motion will do for a light car, but when it comes to a ponderous mass of machinery weighing ninety tons, and attached by compact couplings to a train of cars weighing 850 tons, the impossibility of starting such an enormous weight by a sudden impulse is apparent to any mechanic. The strain on the trolley and the machinery has developed so many weak points that the most expert mechanics in the employ of the electrical companies are racking their brains in the effort to discover some new method of applying the electric force to the machinery, but so far they appear to have had little or no success. A machine of any kind that weighs 180,000 pounds, and has all its weight resting on its driving wheels, must be possessed of vast utility in order to counterbalance its disadvantages on account of the terrific strain on the tracks. Two steam locomotives, each weighing forty-five tons, would probably be as effective in moving traffic as that huge bulk of steel and iron which is proving so troublesome in the Belt tunnel."

STORAGE BATTERIES TO REGULATE THE ANACONDA TROLLEY ROAD.

A contract has been closed with the Anaconda Copper Mines for 270, 500 ampere hour Chloride accumulator cells which will be used for regulating the load on the dynamos operating the trolley line used for hauling material from the mines. The battery will also be used for lighting during two or three months of the year. For the latter work, it will be charged from the railroad circuit and discharged in 5 series in multiple.

THE SPEED THAT ELECTRIC MOTORS HAVE TO BEAT.

In the struggle for supremacy between the Great Northern Road and the London and Northwestern the distance between London and Aberdeen, which is 540 miles by the latter, has just been made in the sensational time of 8 hours 32 minutes or 512 minutes. This shows an average speed of 63.47 miles an hour over the whole distance, including all stops, which leaves all other records for such a distance far in the rear. Before these roads began their record-breaking struggle, the New York Central held the palm by making the run of 436½ miles from New York to Buffalo in 425¾ minutes actual running time, and 439½ minutes elapsed time, including all stops. On August 22, the Great Northern smashed the New York Central's proud record by making the dash from London to Aberdeen, 527 miles by its route, in 520 minutes. The same day the London and Northwestern was only a shade behind with 540 miles in 535 minutes. But the Great Northern, with its shorter route, was still fifteen minutes to the good in getting from London to Aberdeen. It was this fifteen minutes that put the spur into the iron horse of the London and Northwestern and resulted in its making the long route eight minutes faster than the short route had been accomplished. This great feat was accomplished by traveling part of the journey at the rate of seventy-five miles an hour.

A GERMAN STEAM ROAD CONVERTED INTO AN ELECTRIC.

A VERY important step has recently been taken in Germany looking to the introduction of electricity on steam roads. The first attempt of this nature is now being carried out on the branch road connecting Türkheim and Wörishofen, where the road makes direct junction with the Bavarian state railway. The cars will be of large size, each equipped with motors, and designed to haul the passenger and freight cars of the main road as trailers. At the depot at Türkheim a third standard gauge track will be equipped electrically, so that switching can be done either by steam or electric locomotives. The work is being carried out by Naglo Bros., of Berlin.

TROLLEY "LIGHT RAILWAY" FOR DERBYSHIRE, ENGLAND.

The long and animated discussion in England as to light railways appears to have fruit already in the plan for such a road from Derby to Ashbourne—12 or 14 miles—with side arm trolley suspension. It is proposed to build the generating station near the Brailsford Brook, about 7½ miles from Derby, as that seems to be the best site, the heaviest part of the road being at the Ashbourne end. If sufficient hydraulic power could be obtained from the brook a large saving might be made in generating the current. The following is a rough estimate showing the cost of the line: Cost of permanent way, including materials, laying, etc., £25,600; overhead equipment, £18,600; generating station, including land, buildings, engines, etc., £12,000; rolling-stock, including six motor cars, six travelling cars, and six goods cars, £6,100; total, £62,300 ($315,000). It is estimated that there would be 19,280 journeys made per annum, and that the mileage would be 250,000 per annum. The cost would be about 12 cents per mile, or a total of $31,000 per annum. The population of the district is about 105,000, and assuming—as is quite reasonable—that the number conveyed annually, reached that figure, the income from passenger traffic alone would come to $95,000. With regard to traffic along the road, 600 traps have been counted through the Mackworth Toll Gate on one Friday.

The Hartford, Conn., Street Railway Co. has taken an old horse car and turned it into a peach freight car, bringing the peaches in from Glastonbury for the merchants who buy them. Peaches by trolley are voted a great success down Hartford way.

JEFFREY COAL HANDLING MACHINERY IN THE COLUMBUS, O., STREET RAILWAY PLANT.

The general application of labor saving appliances to power plants, is becoming more general every day, especially in the stations of street railway companies. We illustrate herewith an installation of coal handling machinery, recently erected by the Jeffrey Manufacturing Company, of Columbus, O., in the new and well equipped power station of the Columbus Central Street Railroad Company at Columbus, Ohio. This power station is one of the finest of its kind, not only from an architectural standpoint, but also in its mechanical equipment. The Jeffrey Manufacturing Company designed the coal handling machinery for this plant. The coal which is usually nut, slack or pea is brought in ordinary railroad cars upon the side track, immediately adjoining

Coal Handling Machinery in The Columbus, O., Street Railway Plant.

the power house. The coal is then discharged into a large V-shaped hopper of a size to admit the storage of ten cars; from this hopper the coal is taken by a Jeffrey conveyer, thence under the roadway, a distance of about 100 feet, and is discharged into a Jeffrey bucket elevator inside the power house. It is then elevated to a height of 35 feet and is discharged into another Jeffrey conveyer, located upon the top of the storage hoppers. The coal hoppers are connected with the automatic stokers by specially arranged spouts, and by means of valves and levers, which are controlled by the man in charge, the coal is fed into the stokers as may be required. The coal hoppers are built of heavy sheet steel supported by wrought iron pillars. A small stationary engine drives this coal handling machinery, while the whole plant is of a capacity of more than double the present requirements of the power plant, which is now equipped with boiler capacity of 1,500 H. P.

THE NIAGARA FALLS GORGE ROAD.

The Niagara Falls & Lewiston R. R. (known as the Gorge Road) is already running over part of its track, having about five miles finished, from Lewiston to the Buttery elevator. The entire road will be seven miles double track. The company, of which Mr. J. M. Brinker, of Buffalo, is president, is getting its power from the Hydraulic Power & Mfg. Co.

"FIRED" FOR TAKING RISKS.

The Detroit Citizens' Railway Co. has recently discharged five car crews, ten men in all, for taking undue risks at railroad crossings. There is a state law on the subject and the company has also stringent rules.

PENNSYLVANIA STREET RAILWAY CONVENTION.

The fourth annual Convention of the Street Railway Association of Pennsylvania opened on Sept. 4 at the 9th Regiment Armory, Wilkesbarre. The sessions were held in the head quarters rooms, while the large drill-hall was given up to an exhibition of street railway supplies. President J. A. Rigg called the assemblage to order at 11 o'clock, and over a hundred delegates were present. Mayor F. M. Nichols welcomed the delegates cordially, but he took occasion to criticise the "greediness of the average street railway companies," several instances of which he quoted. J. R. Kenny of Berks county made the response instead of President Rigg. A. K. Balor, of the General Electric Company, spoke in the afternoon on "Power Consumption by Electric Railways." The subject was divided into two parts, the first being the apparatus itself, efficiency, etc.; second, handling methods and practices in the operation of street railways. The rest of the afternoon was taken up with general discussion on "The Laws of Street Railways," "The Prevention of Accidents and the Adjustment of Damages," "Belt Lines in Inland Cities," and "State and Municipal Taxation of Street Railways."

In the evening a complimentary concert was tendered the delegates, and on Sept. 5 there was an excursion over the Traction Company's line in the Wyoming Valley, followed by lunch.

The officers elected were B. F. Meyers, Wilkesbarre, president; John Lloyd, Altoona, first vice; R. E. Wright, Allentown, second vice; S. P. Light, Lebanon, secretary; W. H. Lanius, York, treasurer. The exhibits were good but not numerous.

A "TRILBY" CAR.

Some new trolley party cars have been built by the Philadelphia Traction Company. They have been built especially for trolley parties, and are all of the same size and design. They are reconstructed from the largest and best of the old cable cars, though little more than the frame of the old cars remain. The first car came out of the shops recently, and the other three will soon be finished. The first car is 34 feet long, and is mounted on double trucks. It has an aisle in the middle and is provided with reversible cane seats. A bronze rail at the sides prevents accidents from persons leaning or falling out. There is no foot-board at the side on which the more frolicsome spirits of trolley parties can ride. The car has been named "Trilby," and the word is spelled in letters of electric fire on the transom at each end. Its decorations are very artistic, being entirely of green and white lights, arranged on hangers of green and white China silk. There are more than 400 lights, inside and out, and the effect is said to be beautiful.

SUBURBAN RAILROAD WORK AROUND ST. LOUIS.

Mr. G. W. Baumhoff, superintendent of the Lindell Railway Co., St. Louis, has contracted to build about ten miles of road for the St. Louis & Kirkwood Railroad Co., commencing at the southwest corner of Forest Park, thence in a southeasterly direction passing through Brentwood, Tuxedo Park, Kirkwood and Meramec Highlands, which is the western terminus; returning over the same route and connecting with the Chouteau Avenue division of the Lindell Railway. For this work, 60 pound T-rail will be used throughout, and the overhead trolley wire system. This road is strictly suburban, and will, it is said, cut into the commuter traffic of two steam lines.

SIXTY-ONE MILES AN HOUR.

Since Aug. 4, the electric locomotive in the Baltimore tunnel has been hauling the entire freight service of the B. & O. line through the tunnel, and on Sept. 6, it made a speed test at the rate of 61 miles an hour, equal, it is said, to about 75 miles an hour on the level.

Mr. George Gould is reported to have sent experts to Chicago to study the working of the electric elevated road there.

The Camden & Atlantic Railroad Co., at its semi-annual meeting at Atlantic City, N. J., last week, discussed the substitution of electricity for steam on its system; but did not announce any conclusion.

The Siemens-Halske Electric, which recently acquired the Grant Locomotive Works, in Chicago, has now brought out a new steam locomotive for which many advantages are claimed. It does not propose to get left at either end of the game.

The Lenox Avenue Conduit Road has been such a success that it will be extended, and other branches of the Metropolitan system will eventually be equipped in the same way. Meantime, the company has difficulty in getting the material for its extension of the Lenox Avenue line, and has still to find out how things work in winter.

LETTERS TO THE EDITOR.

VIOLATIONS OF UNDERWRITERS' RULES IN NEW YORK.

The article which you published in your paper, under date of August 28, in relation to the disgraceful condition of the electrical wiring at St. Luke's Hospital, has been the cause of the writer receiving correspondence from contractors in this district, in which they express their appreciation that the matter has been finally taken up, and the inquiry set on foot why it is that the particular contractor who did the work at St. Luke's Hospital has been permitted at various times to do work equally as bad as, if not worse than, that at St. Luke's; and in the correspondence attention is particularly called to the electric light wiring placed in position by the contractor of the St. Luke's equipment in the New Criminal Court House, erected some two years ago on Centre street. Attention is also called to the unquestionably shameful work placed in position in the Hotel Majestic.

The writer has replied to these letters by stating that it was not his intention to attack any individual contractor or firm, but to mention a specific case of disreputable work, to say the least, for which the New York Board was primarily responsible, and which never could have been placed in position if it had not been for their action. The writer is fully aware of the conditions which existed, and which still exist on the two equipments mentioned (the New Criminal Court House and Hotel Majestic) and probably every consulting electrician and contractor in this district is also fully aware of these conditions, but they probably do not understand how it was that such conditions could arise with the New York Board having full knowledge of the facts in both cases.

The writer certainly desires to have it said to the lasting credit of Mr. Forsythe, of the New York Board, that in both cases just mentioned the work was condemned by him as improper and unfit, and that he used his best efforts to forestall the placing of such work in position.

If it had been the intention and desire to outline for the benefit of the readers of your paper, buildings in which work had been placed in position which was neither in accordance with the rules of the Underwriters, nor in accordance with the rules of good electrical engineering, a special edition of your paper would have been absolutely essential, and from daily observation made of the present class of work being placed in position in several of the buildings in this city, work of the same grade and character as that placed in position at St. Luke's Hospital is being executed.

The consulting electrical engineers and the reputable contractors (who are largely in the majority) should unite and enter upon a vigorous warfare against just such work as has been mentioned from time to time by the undersigned, and against which it is impossible for honest contractors to compete.

FREMONT WILSON.

NEW YORK, Sept. 4, 1894.

THE RELATIVE ECONOMY OF CONSTANT POTENTIAL AND CONSTANT CURRENT ARC LIGHTING.

I had not intended to again trouble the ENGINEER with any further disquisition on the above subject, but as the matter has been so fully gone into by Mr. Knowles and Mr. Wynkoop it may be timely to again refer to one interesting point in the discussion, so far not fully elucidated.

In my first communication I conceded, as claimed by Mr. Knowles, a loss in dead resistance on a constant potential arc circuit of 140 watts. While this is theoretically true, what are the facts in current practice?

Out of a very large number of specifications for arc lighting plants examined by the writer in past years, the majority called for 480 watts per lamp for constant current apparatus; that is, 50 volts per lamp times 9½ amperes, with an allowance of 5 watts, presumably for line resistance. This may fairly be considered current practice so far as constant current lamps are concerned.

Careful experiments at one of our Western universities have demonstrated the fact that a cored upper carbon gives a much better light at 8 amperes than does a solid upper at 9½. On a three-wire or other 220-volt circuit, four arcs are commonly used in series; with a dynamo potential of from 230 to 250 volts, to allow for drop in line, we can count on an average potential at the machine of not to exceed 240 volts; 8 (amperes) times 240 (volts) equals 1,920 watts, divided by four (lamps) gives us 480 watts per lamp, the same as with constant current lamps. Of course the better carbon can be used in the constant current lamp, but dealing with facts as they exist in every day practice, we get the same, or a better, light from the same number of watts with constant potential lamps as we have been using in the constant current lamp, plus a better dynamo efficiency, large units, etc. In other words, we gain at least 25 per cent. in cost of production, all factors considered.

If the cored carbons are used as they ought to be, in lamps properly designed to give a fourteen hour service with one pair of carbons, and different lengths used at different times of the year, according to the lighting hours, the cored carbons at present prices will not cost one cent more than the solid. I shall therefore answer Mr. Knowles by stating that I *should* use the constant potential system for a plant designed to do arc lighting exclusively, provided, of course, the cost of copper was not absolutely prohibitive.

But the modern engineer seldom has to deal with work calling for arc lighting exclusively; such conditions existed only in the early days of the business, before people found out that incandescent lighting could be had. Not only our cities but even our smaller villages are to-day using electric light, and there is no demand for an exclusively arc system. That system which gives us everything from one large machine of the greatest durability and efficiency, with the least possible complication, fewest employees and a minimum repair bill, is bound to survive. And it would seem that the constant potential system most nearly meets the wants of the present.

There are many things in this world which make us tired, and some things which make us more tired than other things; one of these is the constant repetition of the statement that constant potential arc lighting is not economical. The discussion to which you have so kindly given so much space may serve to show up the truth of the matter, especially when we get the figures which Mr. Wynkoop promises; we have loads of them here, from plants on a smaller scale than that in Brooklyn, and they are entirely satisfactory to those who believe in the new way of doing things.

W. N. STEWART.

MINNEAPOLIS, MINN., Aug. 28, 1895.

IMPORTANT NEW PATENT OFFICE RULE.

Heretofore inventors have been accustomed to make use of the two years' time in which to prosecute an application before a Primary Examiner in the Patent Office. The new rule allows only six months and went into effect April 15, 1895. Pending cases will be affected as though the last office decision were upon that date; therefore, all applications which were pending before that date should be amended or argued before October 15, 1895.

This is the essential feature of the rule and important at this time, because of the near approach of the limiting date, and the undersigned takes this opportunity of informing probably hundreds of inventors who may be depending upon the two years' limit.

EDWARD P. THOMPSON.

SOCIETY AND CLUB NOTES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The 99th meeting of the Institute, will be held on Wednesday, September 25th, the date having been changed from September 18th, by the Committee. A paper will be presented by Mr. Charles S. Bradley, on "Phasing Transformers." Meeting of Council will also be held September 25th. Applications have been received from over 30 candidates, for admission as new members.

N. E. L. A.

The Executive Committee of the National Electric Light Association proposes to hold a meeting this week to discuss the proposition to have an extra exhibit of electrical apparatus at the annual meeting in this city next year. President Wilmerding has sent a circular letter to the supply houses asking their views and advice.

CANADIAN ELECTRICAL ASSOCIATION.

This association will meet for its fifth annual convention at Ottawa, Can., on September 17, 18 and 19 when a good programe of business, papers and pleasure will be carried out. The Russell House will be headquarters.

THE NEW YORK STATE RAILWAY ASSOCIATION meets at Albany on Sept. 17.

THE OLD TIME TELEGRAPHERS meet on Sept. 11, 12 and 13 in this city, with headquarters at the Broadway Central Hotel. A royal time is expected. It will be the Fifteenth Annual Reunion.

THE AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION held its fifth annual meeting at Toronto, on Sept. 3, 4 and 5, when a number of reports and papers of interest to the medical profession were presented

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE has been holding its annual meeting, at Springfield, Mass., with wonted success. There was, however, little of interest to electrical engineers. In connection with the meeting, the Society for the Promotion of Engineering Education held its sessions. Papers were presented, with regard to electrical study, by Prof. D. C. Jackson and G. D. Shepardson.

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CONTENTS.

CITY ELECTRICIANS.

OF late years, the tendency in all electrical work has been towards specialization, and while to-day there are some men fairly well versed in many branches of the art, we doubt if a single one can be found who will assert that he is an expert in all. The younger engineers coming to the front are broadly educated in the various electrical engineering courses, but the moment after graduation, or even before it, they have made up their minds as to the particular field to which they will specially devote their energies. There are, of course, versatile men who move easily from department to department, but we fancy that their number is much fewer now than it once was; or perhaps it is that the art has widened all around them. We doubt seriously whether Mr. Edison is in close touch with some important work. Prof. Elihu Thomson has left certain branches severely alone, and Mr. Brush neglects every one. Mr. Tesla invents neither telephones nor telegraph keys. Prof. Short once sold telephone patents for a neat little sum, but to-day he is concentrated on long distance railway work. Mr. T. D. Lockwood, nimble minded as he is, has sacrificed pretty well everything for telephony. Prof. Houston writes manuals and dictionaries, and Mr. F. L. Pope has become historian to the profession.

But while all who are familiar with the magnitude of electrical development recognize the necessity of this devotion to specific pursuits, if eminent success is to be achieved, American municipalities are beginning to call for a class of men who shall unite a most bewildering range of qualities and aptitudes. We refer to city electricians, who multiply apace, and who in a few years, at the present rate of increase, will be hundreds strong. Ten years ago, there were not half-a dozen of them. Mr. Barrett, of Chicago; Mr. Walker, of Philadelphia, and Mr. Mead, of Pittsburgh, are among the first to whom the designation was applied, but even now, the titles vary and the duties are of a most onerous and miscellaneous nature. In New York, we have a Board of Electrical Control, but not a City Electrician; a good Superintendent of Fire Telegraphs—Mr. J. Elliott Smith—but no one to check the vagaries of the Board of Fire Underwriters. In Brooklyn, the work is split up between Prof. Plympton, Mr. Frank Mason and Mr. Watson; and so it goes all over the country.

We believe that the time has come when it is worth the while for cities of any size, to have a good Electrical Bureau of their own, with a good man at the head, and with competent subordinates; and the tendency of things is this way. At present, where no such central and unified authority exists, the chaos of rules, regulations, ordinances, franchises, and happy-go-lucky methods is appalling. If electricity were not the wonderfully safe thing it is, half our cities would have burned up long ago, and tens of thousands of our people would have been killed, so indefinite, uncertain and contradictory have been the control and supervision of the work done. But now, when every art and industry is being electrified, and when every city is beginning, almost in spite of itself sometimes, to have several electrical services, it is time to establish on firm ground the City Electrical Department and to have a good man at the top.

Where a city is unfortunate enough to have a municipal lighting plant of its own, the need for a City Electrician is obvious, but even when the light is contracted for, an official of integrity is needed to supervise the pole lines, see that the city gets its service efficiently, keep down the number of wires, and probably manage a subway system.

Then there is the enormous mass of inside wiring, with regard to which, until recently, few cities have had anything to say, so that electrical contractors had been bothered to death by the various insurance rules, good, bad and indifferent. Then there are the fire alarm system, the police signal system, the telephone service of the municipal buildings; and the electrical bell work from office to office. In Chicago, Mr. Barrett has lately had to deal with complicated problems of city pumping by electric power; in Davenport, Ia., Mr. Goldschmidt has had to look after the collection of a yearly tax on 5,000 poles in the street; in many cities, the questions of electrolysis from trolley lines have been referred to the city electrician; and now, last of all, many towns in Ohio have begun to put in municipal telephone exchanges, under a city officer.

We are far from regretting this magnification of the office of City Electrician. It seems to us an entirely right and proper thing, and while all these duties are a serious tax on the ability of any one man, we think that as time goes by, this type of electrical engineer will also become specialized—if only by his being a little broader man than those who narrow themselves down to determined careers in limited fields. This creation of a new market for talent should encourage the colleges that have laid out generous lines of electrical engineering study and reward them for their foresight and liberality. But it will be preposterous to expect and impossible to command the talent adequate to the work unless salaries are better. We cannot name a City Electrician whom we consider well paid to-day; and we can only hope that the increase in the duties will soon bring with it better recompense. The Patent Office cannot keep its men long, and the municipalities will not be more successful in retaining expert skill unless they give these highly trained and experienced men what they are worth.

WELSBACHS vs. ARCS FOR STREET LIGHTING.

At regularly recurring intervals we hear reports of improvements in processes of gas manufacture or gas utilization which will result in the final relegation of the electric light to innocuous desuetude. It is needless to say that thus far none of these predictions has come to pass. The most recent "scares" of this kind have been based on the Welsbach burner and on acytelene gas. The latter has hardly yet emerged from the "exhibition" stage and until more definite information is at hand as to the cost of producing carbide of calcium electrically in large quantities and inodorously no comparison can be made as to the competing power of this new aspirant for lighting patronage. But the persistency and energy of the promoters of the Welsbach light have already put more than one central station manager on his mettle. Thus far the competition has been between the Welsbach and incandescents for interior illumination; but it would seem that some energetic gas people are looking for larger fields to conquer and would even pit their new creation against the arc lamp for street illumination. The proposition seems almost ludicrous, but is nevertheless put forward with apparent seriousness by Senator McMillin, President of the Laclede Gas Light Co., of St. Louis, who claims that with the Welsbach burner streets can now be lit with gas more satisfactorily for the same money than can be done with electricity. Were it not for the cost of lighting and putting out the gas jets, he avers, the gas company could to-day light the city of St. Louis for 50 per cent. less than when the gas company had the previous contract, and give 25 per cent. better service.

It is hardly necessary to say that the statements cited above are apropos of the approaching expiration of the city electric lighting contract, and hence on that account alone ought to be taken with a grain of salt. But aside from this fact, we think that Senator McMillin would have a pretty hard time proving that gas in any form can light the streets *more satisfactorily* for the same money than it can be done by electricity at the present ruling prices for city electric light service. Whatever merits the Welsbach burner may have as an illuminant for interiors, it has *not* been proved adequate for street lighting, subject as it must be to the inclemency of the weather, street vibration, and comparatively rough handling. The cost of lighting and putting out the gas burners which has stood in the way of the reduction of cost with gas, so deplored by Senator McMillin, is unfortunately still to be contended with, but we had no idea that nearly 50 per cent. of the gas company's receipts went into the pockets of the St. Louis lamp lighters. How fortunate, for electric light companies, that a turn of a handle at the station puts them in a position to pay dividends! But whatever foundation in fact Senator McMillin may have for his statements, we think that he has reckoned without his hosts. The American public, we are convinced, has cut loose for good from gas as a street illuminant. We need only point to the number of municipal electric light plants now installed and to others going in all over this country to show that the electric light is the only light which is at all considered "satisfactory" for the purpose. No one will accuse our gas friends of lack of enterprise, but we have yet to hear of a municipal gas plant installed, in this country at least, since the advent of electric lighting. While, therefore, we apprehend no interference with street lighting work by the gas companies, the note sounded by Senator McMillin may well be considered as indicating the drift of the opinion and effort of some of our gas friends, which ought to be kept steadily in mind by members of the electric light fraternity ready to slacken the march of improvement.

WHAT IS THE SPEED OF THE TELEPHONE?

We print this week a most able and interesting communication from Mr. P. B. Delany in which he follows up and strengthens his arguments in favor of mail telegraphy. He holds to his contention that the telegraph, in its present condition, has fallen far behind the wants of the age, but he adds that even the telephone and telegraph combined barely scratch the surface of possible work. The figures do not impress us so much against the telephone, as they do Mr. Delany, for admitting that there are 40 letters exchanged to 1 telegram there are only 4 letters to 1 telephone talk, which, we think, tells more than anything else the marvellous hold that the telephone has secured on social life in less than 20 years. The number of letters would at any rate be greater by 800,000,000, or thereabouts, if we had neither electrical agency; and it remains to be seen how much further, by cheaper telephony and Mr. Delany's radical scheme of mail telegraphy, the present three billions of letters can be reduced.

This discussion is barely opened, it would seem, and we shall therefore have several occasions to return to it and the principles involved; but meantime we would greatly like to see taken up the challenge that Mr. Delany throws down to the telephone. It is of course a very serious objection that the telephone offers no record—a defect that presents an opportunity to the Gray telautograph; but Mr. Delany further says calmly that the telephone, with two wires, is good only for 60 words a minute, and, even with a stenographer, its higher capacity is doubtful. We differ from Mr. Delany in toto, but it is curious that there are no statistics in support of the high speed of the telephone. It would be extremely interesting to have an authentic, official test made; and we venture to suggest it to the Bell authorities—say for a conversation and a transmission of news between New York and Chicago. The data for argument in the case will then be more available and specific.

TELEPHONY.

THE STRUGGLE BETWEEN TELEGRAPH AND TELEPHONE.

BY PATRICK B. DELANY.

I HAVE been much interested in the attention you have been giving to the telegraph and telephone situation of late, and although in general touch with both subjects, I was startled by your graphic presentation of the power and proportions gained by the telephone during the few years of its existence.

It is easy to understand that if the telegraph and telephone continue their growth in the future in the same ratio as in the past, it will not be long before the telephone is greater than the telegraph, in property and earning capacity. Indeed, judging from the great disproportion in the development of the two systems, and the constantly increasing gains of the telephone relatively, the decline of the telegraph, if conducted on the present plans, may be reasonably expected.

There is no escape from the self-evident fact that the telephone has been managed with energy and enterprise, while the telegraph has been guardedly confined to the old conservative grooves, blind to the march of events, and deaf to the demands of development. Before the telephone was born the telegraph might have, to a large extent, occupied its field and earned a large revenue from telegraphic *conversations*. The demand for such facilities was *forced* upon the notice of the telegraph companies constantly, but the idea was frowned down, and only in rare cases, and as a great favor, were privileges of this kind granted. It is my firm belief that even at this late day type-written conferences by telegraph would be popular and profitable if the telegraph companies would take the trouble to bring people to the ends of the wire as the telephone companies are doing.

Viewing the whole subject of communication and correspondence broadly, one cannot fail to be impressed with the fact that after all the telegraph and telephone combined do but a small proportion of the work. There are about three billion sealed letters carried by the Post Office during the year, or about 40 letters to one telegram, and this difference in number is owing mainly to the difference in cost.

It might as well be admitted at once that the telephone holds the field for local communication, mainly because of the subscriber system, the lump sum yearly charge, regardless of the number of messages, and its ever ready facilities. The local telegraph, as every one knows, is slower than the long distance lines. It takes less time on an average to send a telegram from New York to Chicago than from Madison Square to Wall St. Nor is the telephone service to occasional or outside users much better in this respect, as everybody that has wrestled with a local pay station outfit, its "Hello's," "Number's," "Busy now's," etc., etc., can testify. With subscribers it is different The facilities are so much more convenient and the service so much quicker, that in these days no telephone subscriber would think of sending a telegram to his correspondent in the same town.

Leaving local communication to the mails and the telephone, the more important question of communication between distant points is the one to be dealt with, and it is to this domain that the struggle for supremacy between the telegraph and the telephone will be confined.

I cannot believe that telephony at nine dollars for five minutes' use between New York and Chicago and proportionate charges all over the country will ever become popular to any great degree, even though it should yield the 150 words per minute with which you credit it, a speed however which I think is more than double its capacity in the hands of the average user. There are but few public speakers that will average 150 words per minute in delivering an address. That such a rate can be wrung out of a telephone with all the interruptions, repetitions, and miscellaneous skirmishing in getting down to work, seems highly improbable.

It seems to me that a word a second, 60 words per minute, or 300 clearly understandable words in five minutes, would be a very liberal rate for telephony, and this without any record, unless one employs a stenographer to take it down, thereby adding to the trouble and expense, and introducing another fertile element of doubt and distraction. When it is remembered that this rate of 60 words per minute involves the use of *two* wires, the capacity of the telephone for correspondence is not as great as that of the telegraph, even with its present slow method of hand working; for a quadruplex will carry 60 words per minute over one wire. Reckoning the eight operators engaged in the telegraph work as a partial offset against the second wire of the telephone, matters will still be in favor of the telegraph with the additional advantage that in the case of the telegraph the 60 words per minute may be type-written, whereas the telephone message is in the user's head, not always a reliable reference.

The cost of 300 words typewritten by telegraph at regular rates would be $9.10, or ten cents more than the telephone charge, assuming 300 words to be a fair clean up product of five minutes' conversation.

Thus it would seem that as at present organized for work the telegraph and the telephone are about on a level. But the telephone has insuperable advantages in its subscriber system and the facilities afforded for *completing* a conference or transaction on the spot. So long as a business man in New York can, without leaving his office chair, confer with another business man a thousand miles away, and get his reply on the moment, he will pay the price *whenever the occasion warrants*, but he will not write telegrams, send them to the telegraph office and wait from one to four hours for the answer, *at the same cost*.

It is plain however that at the present rates the telegraph and telephone combined cannot get more than four or five per cent. of the number of messages carried by the Post Office. They will continue to be used in cases of urgent necessity represented by this percentage and no more.

In the battle for supremacy, the telegraph is infinitely more resourceful than the telephone. With the present system of operation, but five per cent. of the carrying capacity of the present telegraph wires isutilized, and with larger copper wires speeds may be enormously increased. Not so with the telephone; the speed of which must, under most favorable conditions, be limited to the rate of human articulation.

When telegraphy is broadened to its proper function the mails will be carried by it over all important routes, and the railway time for a letter from New York to Chicago will be practically eliminated, or reduced from about 25 hours to the telegraph speed of a few seconds—and with a rate of 15 cents for 50 words, or 90 cents for 300 typewritten words against nine dollars for the same message over the telephone, using two wires, the degree of urgency requiring the use of the telephone would be of great rarity, while at the same time, the incentive to save so much time over the regular mails would result in an enormous traffic for the letter telegraph.

No telegraph engineer will now deny that it is practicable to send 1,000 words per minute over an 850 pound per mile copper wire from New York to Chicago, producing a record from which type written translation can be made at the rate of 50 words per minute, or that 1,000 words can be prepared for transmission as quickly and as cheaply as it can be telegraphed by hand. Therefore it would be difficult to avoid the conclusion that automatic or machine telegraphy with chemical recording, will carry the bulk of the correspondence too urgent for the regular railway transportation and not urgent enough for the telephone and its great expense.

Letter telegraphy is only a question of copper, construction, and chemical automatic working. The telegraph with a differentiated service, amplified to meet the various grades of exigency, and with rates made possible by machinery which will bring into use the 95 per cent. of efficiency now wasted, should stand in no great dread of the telephone.

APPEAL OF THE BERLINER CASE TO THE U. S. SUPREME COURT.

In the U. S. Circuit Court at Boston on Sept. 3, the United States took an appeal in the Bell Telephone case involving the validity of the Berliner patent.

In the United States Circuit Court of Appeals, Judges Colt, Putnam, and Nelson sitting, Counsel J. J. Storrow for the appellant, in the case of the American Bell Telephone Company vs. The United States, made a motion for a mandate dismissing the bill brought by the United States, in accordance with the decision of this court on the appeal of the Bell Company. The Court forthwith ordered the mandate to issue, whereupon Counsel Causten Browne, for the Government, took an appeal in open court, and the appeal was allowed. The appeal takes the case before the United States Supreme Court, and has the effect of superseding the mandate, leaving the case in statu quo, to be heard anew by the court at Washington.

The first decision in this suit by Judge Carpenter was in favor of the Government. The case was taken to the United States Circuit Court of Appeals, where the decision below was reversed. The action taken by the same body now in permitting an appeal to the United States Supreme Court, settles a point of jurisdiction concerning which there had been some doubt. The right of appeal to the Supreme Court in patent causes is now most strictly limited by the creation and existence of the Circuit Courts of Appeal.

LONG DISTANCE TO LOUISVILLE, KY., OPEN.

ON Sept. 6, Mr. W. A. Vail, co-operating with Capt. Gifford and the local exchange, threw open to public use the long distance line which brings Louisville in touch with telephonic civilization. The first talk to New York was had between Police Commisioner Fred Grant and President Logan Murray, of the Louisville American National Bank.

TELEPHONES IN CASES OF SICKNESS.

THE Southern New England Telephone Co., under the able direction of President Morris F. Tyler, has always been one of the most progressive organizations in the field. It has to-day 6,446 telephones in the State limits, and has greatly developed its long distance and other services. It has at present no less than 200 men engaged on construction work.

A novel idea, just put into execution by the Southern New England Company has occasioned considerable comment. A few weeks ago a circular letter was sent out to all physicians in New Haven whose offices are connected with the exchange of the Southern New England Company, explaining the details of the plan. The letter stated the fact that in many cases sudden attacks of illness made the use of a telephone from the house of a patient to the residence of a physician of the greatest convenience. To meet this need the company announced that upon the request of a person in the city limits and with the endorsement of the physician attendant, a telephone would be placed in the house for a period of thirty days for the sum of $5, and if the family wished then to continue the service, the same rates would be made for each succeeding month.

The letter outlined a scheme which has never been tried in this part of the country, if anywhere, and its outcome has been awaited with considerable interest. Superintendent Baker was asked the other day how the plan was succeeding. He said:

"We place the temporary telephones in residences simply as an advertisement for the company to show the people what a benefit an instrument is. We have not yet met with responses enough to pronounce the idea a success, but it seems as though, in a case of illness in a family, $5 would be a nominal price for insuring prompt telephone service. We certainly are putting in the telephones for the bare cost of materials and labor. The idea was proposed by Morris F. Tyler, president of the company."

Several physicians who were asked their opinion on the matter stated that they thought the plan was an excellent one, and one which favored them exceedingly.

TELEPHONIC COMPETITION AT WABASH, IND.

A special dispatch of Aug. 22 from Wabash, Ind., says: The Central Union Telephone Company to-day submitted propositions to local business men to supply service for one year at $1 per month for business houses and 66 cents per month for residences. This is a cut of $2 per month from the old business rate, and $1.30 from the residence rate. The Central Union refused, a few months ago, to make any reduction when appealed to, and the Home Telephone Company was organized by Wabash people and a fine system is about completed. It is on this account that the Central Union makes the reduction. As the Home Company has 188 year contracts, it is letting the other fellows do the fighting.

THE FENCE TELEPHONE LINE IN COLORADO.

The Prowers County, Col., Land and Irrigation Company has established telephonic communication between headquarters at Lamar and the office at Granada. There are also four stations between the two points. The peculiar feature of this line is the fact that no wire was strung, the top wire of the railroad company's fence being used in place of the regulation wire insulated on poles. The scheme works admirably, speech being transmitted with great clearness, and there is no trouble from induction. The distance covered by this fence telephone is about twenty miles. Across Clay creek and in the towns the fence wire s connected by telegraph wire.

TELEPHONE NOTES.

LOUISVILLE, KY.—The Ohio Valley Telephone Company will be ready to do business in Louisville about the 1st of September.

ERLANGER, O.—Poles are being set through Boone County for the long-distance telephone line to New Orleans.

MENASHA, WIS.—The Wisconsin Telephone Company has been refused a franchise at Menasha, the vote being a tie of the city council.

BALTIMORE, MD.—Electricians Jacob E. Miller and Samuel R. Boone, of the City Police Department are recasting the whole telephone service, which is being greatly improved and extended. Metallic circuits will be used.

BALTIMORE, MD.—The Standard Telephone Company of Washington and Baltimore City, of Baltimore city, has been incorporated with a specified capital stock of $140,000, by Messrs. John W. Woodland, Bruce B. Gootee, General Felix Agnus, Wm. S. Thomas and Robert M. Galt, all of Baltimore, as incorporators. The directors named include all of the incorporators except Mr. Thomas, and also Messrs. Theodore J. Mayer, Elbridge S. Johnson, George W. Cross, Lemon G. Hine, Frank Hume and Wm. W. Fierce.

LAKE FOREST, ILL., is being provided with a telephone service.

MARBLE CITY, COL.—A telephone line is to be built between Marble City and Crystal.

BLOOMINGTON, ILL.—The Home Company promises to be in operation by September 1st.

MCKEESPORT, PA.—The Bell Telephone Co. is about to compete with the new local company and offers cheaper rates.

PORT BYRON, N. Y.—A telephone line has been constructed between Port Byron, Conquest and Spring Lake.

WESTMINSTER, MD.—The plant of the Western Maryland Telephone Company has been completed.

ATHENS, GA.—The Bell Telephone Company will put in at once a direct line to Atlanta.

ST. LOUIS, MO.—E. P. Woelk, manager of the East St. Louis Telephone Exchange, is looking into the matter of placing all wires in St. Clair and Madison counties underground.

SPRINGFIELD, MASS.—A branch of the Standard Telephone company, which was organized last spring is to be started in Springfield.

LEXINGTON, KY.—The new improved switchboard to be used by the telephone company is expected to arrive in about a week. This new board will be large enough to accommodate 1,000 telephones.

CHESTER, PA.—Joseph Messick, I. E. Cochran, Jr., Joseph Deering, John H. Kerlin, H. V. Smith and Ward R. Bliss have applied for a charter for the Delaware County Telegraph and Telephone Company, which will be organized with a capital stock of $25,000, divided into 1,000 shares of $25 each.

MENOMINEE, WIS., will put in at once a complete telephone system. One hundred and twenty-five instruments at first, and it is expected that number will be considerably increased. The outfit has been ordered from the Standard Telephone and Electric Company of Madison.

ELIZABETH, N. J.—Although the Elizabeth Telephone Company some time ago got a franchise from the City Council to build an opposition local line to the New York and New Jersey Company, the new enterprise lags and no vigorous effort is being made to go ahead with the work of construction.

EUREKA, MO.—In order that it might secure direct telephonic connection with its properties, the Centennial-Eureka Mining company has closed a contract with the telephone company for a branch line from the Eureka exchange to the hoisting works. The construction of the line is to commence at once.

WABASH, IND., is in the throes of a telephone war. A home company, with 180 subscribers, has been organized and will start up in a few days. The rates will be $1.50 and $2.00 per month. The Bell people have ordered an under-cut, and will probably furnish telephones free, if necessary, to kill their rival.

TUNBRIDGE, VT.—The Rapid Telephone and Telegraph Co. has succeeded the Tunbridge and Strafford Telegraph company and has established offices at South Royalton, Tunbridge, Strafford, South Strafford, Royalton, Stoughton's Mills and East Bethel. It will extend its lines to other villages at once.

CLEVELAND, O., will soon have cheaper telephones. The Subscribers' Automatic Telephone company of Cleveland is to be capitalized at $1,000,000. At the head of the local company will be a dozen capitalists and bankers who occupy prominent positions in Cleveland.

GREENWOOD, IND.—The Greenwood Telephone Company, with a capital stock of $3,000, has filed articles of incorporation. The incorporators are Grafton Johnson, J. F. Crawford and Albert Johnson. The company proposes to establish a telephone system in Greenwood.

BUFFALO, N. Y.—The contract for the use of telephones for the Fire Department has been signed. By its terms the department secures the use of 83 telephones for one year from July 1, 1895, for $960. This is $815 less than was paid for the telephones of the department last year.

NEW IBERIA, LA.—The New Iberia Telephone Exchange, a home corporation, is now placing its poles in position and gives promise of excellent service to New Iberia and the adjacent towns. The contention as to the right of the Great Southern Telephone and Telegraph Company to do business here is to be passed on later by the city council.

WABASH, IND.—A telephone war has been opened here when the Central Union Co. reduced its rates from $3 and $2 per month to $1 and 60 cents, for business houses and residences, respectively. The cut was precipitated by the home company, which is just completing its new system and which proposed to furnish service at $2 and $1.50, rates which the Central Union declined to accept.

Electric Lighting.

THE WARREN ALTERNATOR.

Our illustrations represent an alternator that has just been introduced by the Warren Electric Co., of Chicago, in which the aim has been to secure the greatest possible simplicity of construction together with the highest efficiency of operating, both electrical and mechanical. The designers of the machine Messrs. C. C. Warren and H. B. Warren, set themselves the task of building a machine without commutator or collector rings, brushes, or moving wires of any kind, and the result was the machine illustrated in Figs. 1 and 2, built on the "inductor" plan. The armature coils in this machine, shown in Fig. 3, are attached to a stationary removable laminated ring, Fig. 4, which fits accurately into the bell-shaped steel frame, the large circular exciting coil shown in Fig. 3 being attached to the steel frame. As none of the coils are attached to any movable part, it is clear that no brush or sliding contact is required.

The only revolving part of the machine consists of a cast steel cylinder, on which are pressed lamina that form the rotary poles, Fig. 5. Thus constructed the revolving portion of the machine is simply a solid mass of steel, through the polar projections of which the magnetic flux is delivered to the opposite poles of the laminated annulus to which the coils are attached. In other words, the rotating part is simply the core of a magnetic field,—the rotating flux path. It is made to fill the opening in the closed end of the frame shell so closely, and the polar projections move so extremely close to the poles of the annulus as to diminish the air gap reluctance to the smallest fraction, as shown by the fact that less than half of one per cent. of the kilowatt capacity of the machine is required for excitation.

Fig. 4.—Stationary Removable Ring Armature.

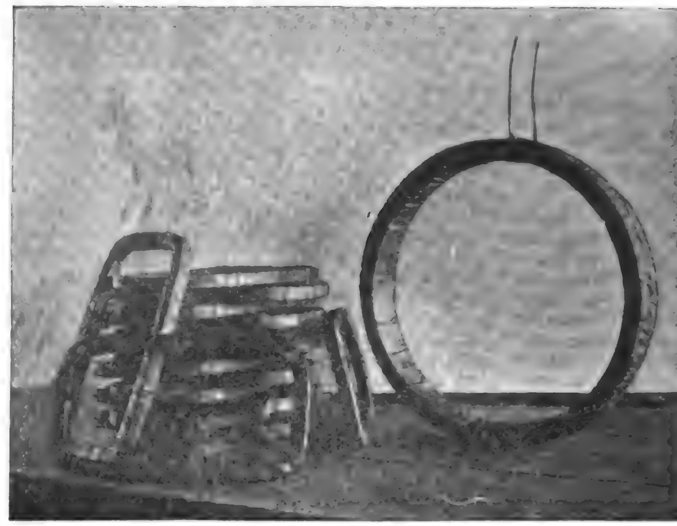


Fig. 3.—Armature Coils and Exciting Coil.

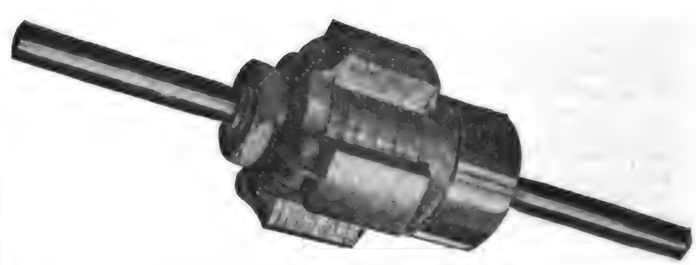


Fig. 5.—Rotating Magnetic Core.

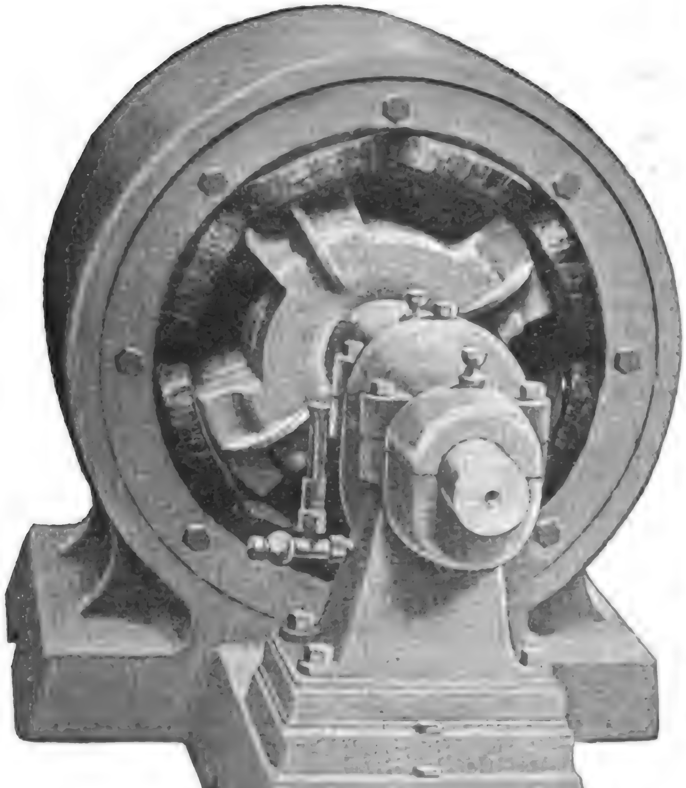


Fig. 1.—Warren Alternator, Open End, Showing Coils and Rotating Magnetic Core.

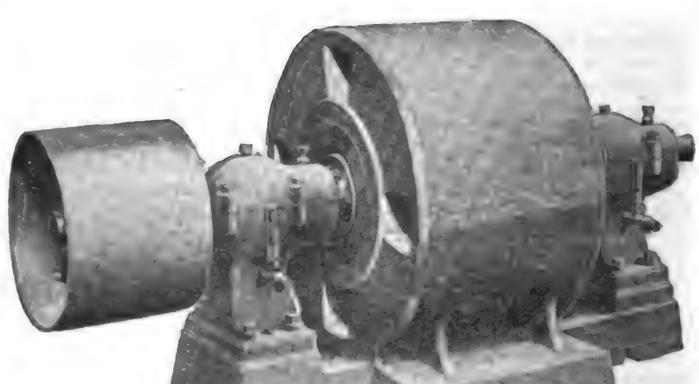


Fig. 2.—Warren Alternating Current Generator, Shown Complete.

The armature coils are wound on forms, are small, and, being attached to the stationary removable ring, are easily replaced in case of an injury from a lightning discharge or accident. Owing to the peculiar construction of the machine, it permits of various ways of connecting up for different voltages without in any manner changing the machine, or requiring new coils. Thus it may be connected for a 110 or 220 volt system, and used without

transformers for short distances; or for 1,000 or 2,000 volts to be used with transformers for long distance transmission; or it may be connected to operate a 110 volt circuit and a 1,000 volt circuit both at the same time.

Its low frequency, (7,200 per minute), adapts the machine to operate arc lamps to greatest advantage and with perfect freedom from the hissing and humming noise at the lamp, which is quite marked when run from alternating currents of the usual high frequency.

The mechanical features of the Warren alternator have had most careful consideration. The exceptionally long self-aligning and self-oiling bearings carrying a forged steel shaft of large diameter, permit running the rotor at the least possible clearance from the stationary parts; thereby reducing the reluctance due to air gap to the smallest fraction.

The 40 and 60 K. W. machines will be built as shown in the accompanying illustrations, with the frame cast of steel in one piece, making a compact and durable form of construction. In larger sizes the upper half will be cast separate and bolted to the lower half in the usual manner. Although the standard frequency adopted is 7,200, the machines will be built for any higher frequency.

KNIGHT TEMPLARS' ELECTRIC ILLUMINATIONS IN BOSTON.

The city of Boston was *en fete* the last week in August, the occasion being the holding of the Triennial Conclave of the Knights Templars, there being nearly 40,000 members of that order present. The quaint old Hub never looked so brilliant, for the citizens vied one with another in their efforts at decoration and illumination, the result being effects that were never surpassed anywhere.

It is no exaggeration to say that since the introduction of electric lighting, nowhere and at no time have more elaborate or extensive illuminations been attempted; this being the candid opinion not only of the people generally, but of those who have had charge of important undertakings of the kind, whether in Europe or America. It would take up too much space to enumerate or describe all the illuminations, but inasmuch as there were two building more lavishly adorned than the rest, it must suffice to give a brief description of those two, dismissing the rest with the statement that all of them were artistic and brilliant. These two were the immense dry goods establishment of Houghton and Dutton, corner of Beacon and Tremont streets, and the Masonic Temple, corner of Tremont and Boylston streets. The work of equipping both buildings was entrusted to the Edison Electric Illuminating Co. and was an immense success.

The first named building has a stone front nine stories high, the two sides standing on the streets mentioned.

Beginning at the top it may be said that along the cornice were the three words: "Fraternity," "Fidelity," and "Charity," formed in red and white frosted incandescent lamps of 16 C. P. capacity, there being 964 in all, the letters being four feet high and thirty-two inches wide, the outline of each letter being formed by a row of red and a row of white lamps. There was also a ring of lamps around the clock which was nine feet in diameter and composed of eighty-five red and white lamps.

Below, on the round corner of the building was the Masonic Compass and Square, ten feet in height and composed of red, white and blue lamps, the blue lamps representing the Masonic Blue Lodge. Four hundred and seventy lamps were required to complete the design. Below was the Templar's Cross, sixteen feet square, containing 1902 lamps, the two outside rows being frosted, the rest red. Then came the word "Welcome" in letters four feet high and thirty-two inches wide. This word had 370 lamps red and white. Underneath were the two letters "K. T." eight feet high and five feet six inches wide, there being 465 lamps in the two letters. On the Beacon street side appeared a "Salem" Cross ten feet high and fifteen feet wide, containing 425 lamps including red and white lamps for the borders, with purple lamps for the body. On the Tremont street side there was first the "Passion" Cross, ten feet high by fifteen feet wide, in which were 204 red lamps. A long streamer was suspended from the roof nearly to the street level down each column, and on each streamer were lamps eighteen inches apart, red and white alternately. The upper points of these streamers were united by arches, thus accurately defining the outlines of the entire building.

By means of a revolving switch, operated by a one-half H. P. motor, the lamps were flashed every fifteen seconds, so that brilliant effects were produced and the color of the entire building changed continually.

The current for this single installation of 5,692 lamps, equal to about 3,000 amperes, was taken entirely from the Edison underground circuit. About ten miles of wire were used, and the entire work was done in less than a month.

In describing the second important and imposing illumination on the Masonic Temple it may be stated that along the cornice across the front were the words "Fraternity," "Fidelity," "Charity" wrought in red and frosted lamps, there being 964 in all, the letters being 4 ft. high and 32 inches wide. Covering nearly the entire front of the building was a huge Templar's Cross 70 feet square, the outlines of which were formed by 518 red and frosted lamps. In the centre of this cross was a Salem Cross composed of 128 amber lamps. At the top of the design were grouped a Cross and Crown, composed of 120 red and amber lamps. In the left arm of the immense cross were Square and Compass, in the centre of which was the letter "G," composed of 167 blue and white lamps. In the right arm of the huge cross was a double triangle made up of 79 red and white lamps, and a Keystone of 137 frosted lamps. Each of these emblems was 10 feet square. The entire installation at the Temple was made up of 2,108 lamps requiring over 1,000 amperes of current which was taken from the underground circuit in the same manner as the larger work above described.

From the foregoing details it will be seen that no less than 7,500 lamps were in circuit; yet notwithstanding that this unusual quantity of about 4,000 amperes was called for from 7 to 12 o'clock every night, the Edison Co. experienced not the slightest difficulty in supplying the current needed.

It is generally considered that the Houghton & Dutton display was the most elaborate ever attempted. It certainly attracted the attention of hundreds of thousands of visitors during the week and was deservedly admired by all.

An idea of the general lavishness of display may be formed from the fact that the Beacon Lamp Co. supplied to the Boston Electric Light Co. some 10,000 lamps for special illuminations, 1,000 going to Keith's Theatre, which is brilliancy itself even under normal conditions.

STATEMENTS AS TO THE WELSBACH BURNER.

The last issue of the *Progressive Age* contains some very interesting data as to the Welsbach burner. As a great many of our readers are directly affected we quote some of the statements:—Messrs. W. P. Biddle & Bro., Welsbach agents at Knoxville, Tenn., write under date of Aug. 21: "We have been selling the Welsbach light since Feb. '93, and have placed about 1,500 burners, of which there are 1,500 burning. We know all the people that use our burners and when we think it is about time for them to have a new mantle, put one on. We have very little trouble with the gas-pressure. We never have to use the reamer, except where the piping in the building is clogged or too small. We only find that on old buildings, as the gas company has issued rules now for piping all buildings. The Palace Hotel, lighted with our burners, now averages a gas bill of about $45 per month, while when they used electrics it cost them about $80 per month, and ordinary tips about $75. We put the No. 29 light in halls and kitchens where there is much draft, as they give sufficient light and no chimneys break. We are experimenting now with street lights. If we don't get the city contract we will make it all the hotter for the electric light company. We have destroyed as many as five oil lamps in one place, a clothing store, and it only took about 20 Welsbachs to replace them. One drug firm here had 14 incandescent electric lights and a gas bill of $3 to $4 each month, making a total of about $17 per month. The proprietor said that if we could bring his light bill down to $10 or $12 he would be satisfied. We sold him nine burners and his bill the first month was $4.80. We have seven drug stores now using our burners. We like the mica chimney and think it a great addition to the Welsbach. One way to use them, where a user has 10 burners, say, is to buy 3 or 4 mica chimneys and keep them moved about from lamp to lamp, always keeping the micas on the worst mantles. We use now, on an average the year round, 100 mantles per month on 1,500 lamps, say."

Mr. John H. Keppelman, Superintendent of the Consumers' Gas Co., of Reading, Pa., sends in under date of Aug. 21 the following interesting information collected from their experience with lighting the streets of that city with Welsbach lights: "We have 308 Welsbach lights in successful operation, scattered all over the city. In some cases they are within 4 feet of steam railroads and at others (and most of them) close to trolley-cars. Neither of these supposed terrors has any effect on the lamps. Neither rain nor storms affect them. Bugs and flies are the only disturbing elements. We mount them in a Philadelphia-pattern square lantern closed all around. Our riser is ¾-inch pipe in which we place the necessary cock, ¾ x ⅛. Then one No. 20 Welsbach light with mica chimney, and around the Mica chimney the Welsbach No. 1028 shade made of glass tubing. The latter we think is quite an addition, as it hides the mantle, diffuses the light, and makes the lamp appear quite massive. We do not use by-passes but light with a match. Our schedule is every night and all night. Of the 308 lamps installed, the first 30 were started on April 18 last; and of these 30, 4 still have their original mantles. We believe we shall be able to operate each lamp with an average of 4 mantles per annum, and were our lanterns tight, or at least bug-tight, not more than 3, or possibly less, would be required. Our lanterns are the property of the city, and had been stored away for many years, out of service. We collected and repaired them, but they are not in the best condition. A convenient bugless lamp would be a great advantage."

Mr. Richard H. Reed, proprietor of Taylor's Hotel, Jersey City, N. J., recently wrote to his local Welsbach agent as follows: "Upon receipt of this I desire that you send a representative down, that I may confer with him in regard to fitting out the rest of the hotel with Welsbach lights. I find those I am using more satisfactory than the electric lights for my purpose, and they have saved enough in gas to pay for themselves at least twice since having been put in. They have reduced my electric light bills nearly $200 per month, and upon the installation of the Welsbach lights I desire to see your representative about, I shall discontinue electric lighting entirely."

What have electric light men to say to this? Our own comment on the situation appears on page 257.

ACYTELENE AND CARBONIC ACID AS ILLUMINANT.

According to Dr. Krüger, of Charlottenburg, Germany, a mixture of equal volumes of acytelene and carbonic acid gas can be used with all ordinary gas burners and gives an excellent light, and which is practically entirely without the explosive qualities possessed by the pure acytelene gas. Compressed acytelene and carbonic acid gas can be obtained commercially in Germany, so that gas illumination can be obtained independent of gas companies' pipes.

MARK TWAIN ON METHODS OF ILLUMINATION.

Knocking over his candle in a Vancouver hotel bedroom recently, on his way to Australia, Mark Twain remarked:—"I look on that candle as a sort of link between gloom and darkness; it is not very closely connected in my mind with the idea of light. I remember very well when most of the hotels were lighted with coal-oil lamps. They were not bad; and if you could get the hall porter to let you have half a dozen of them you could generally decipher the difference between the outlines of the bed and the bureau.

"When gas became more generally used I hailed it as a glorious innovation, and I soon discovered that the economical landlord had a way of dealing with that gaslight that left you a little bit worse off than you were with the lamps. Then came the electric light. I thought that when that came into general use we had as last got into an era of a good bedroom light, but I find that I have again been deceived. They put up a nice electrolier with about four burners on it, but you generally find that three of them have that smoky appearance that betokens a burnt out filament. You send word to the office to have it repaired. For this they keep a bellboy dressed up in overalls so as to look like an electrician. In response to your call up comes this suit of overalls with the bellboy inside of it and monkeys with the burners that won't light up. He pretends to fix them, but he never does. They continue non-illuminant up to the time of your departure.

"Besides that I find that in most of the towns they run their electric light on a fixed-hour system. The light comes in at a certain time and goes out at a certain time. In this hotel, for example, we have to go to bed as a rule with the candle, because the light quits at 2 A. M. In these fixed hour towns it does not make any difference how dark or gloomy the afternoon may be, or how early the shades of evening gather round, you cannot get your light until a certain hour. If it gets dark at 6 P. M. you have to amuse yourself chasing shadows until 8."

UNDERGROUND WIRES IN REDWOOD DUCTS.

The new Mutual Electric Light Company, Mendocino, Cal., in which P. B. Cornwall and A. Bayward are largely interested, is placing underground wires all over the city. In doing this they have discarded the use of terra cotta and substituted redwood instead. They use redwood planks three inches thick, twelve inches wide and from eight to twelve feet long. These are grooved with three to four grooves. The planks are buried four or five feet deep, and one plank placed on top of the other gives sufficient room for numberless wires.

The planks are grooved at a planing mill and taken to works where they are completely saturated and covered with asphaltum. This renders them impervious to water, and there is no reason, it is asserted, why the planks will not last from twenty to forty years.

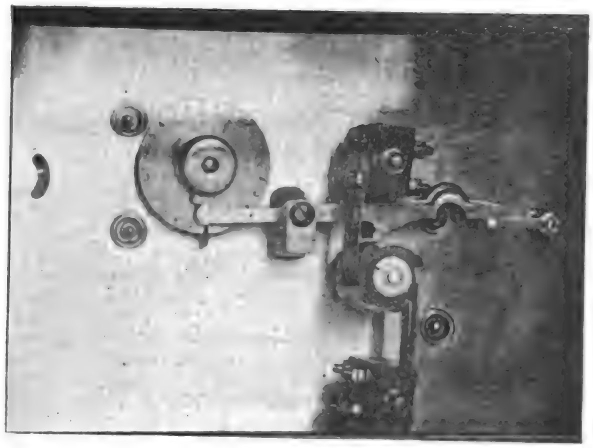
TRYING TOWER LIGHTS AGAIN.

At Springfield, Mo., a movement is on foot to have an electric light tower built in the centre of the square. It is proposed to build a steel tower eighty feet in height and have four arc lights placed thereon. One light will be located forty feet from the ground, one sixty feet and the other two on top.

THE REDDING AUTOMATIC ELECTRIC TIME SWITCH.

This instrument is designed for use in places where it is desired to light and extinguish incandescent lamps automatically at certain specified times. It is therefore particularly adapted for use in stores to light up the lamps in the show-windows on Sunday evenings and holidays; in apartment houses, to light the lamps in the halls on the approach of darkness and extinguish them at the proper time in the evening; and in many other situations where it is desired to light or extinguish lamps or turn on or turn off at more or less frequent intervals, or turn on or turn off the current for any purpose.

The instrument placed in a neat wood frame not shown in the accompanying engraving is provided with an accurate 8-day



The Redding Automatic Electric Time Switch.

clock movement and time dial to show the exact time of day and to operate the switch. The latter is double poled, very powerful in action, and will control any number of lights or quantity of current desired.

In the engraving, the time dial is shown on the left. In front of the dial are two brass wheels or cams with a single projecting tooth on each which control the action of the switch; one cam turns the current on and the other turns it off. The cams can be turned around on the dial so as to set the teeth opposite any hour desired and when so set and secured by means of a set nut, they will turn with the dial and at the designated time press on the two levers also shown in the engraving.

When the first tooth is brought around and pressed against the lever opposite to it and that lever is depressed it releases the cylinder of the switch, allowing it to make one-quarter of a revolution and closing the circuit. The switch then remains stationary until the second tooth is carried around and presses against the other lever. That lever is then depressed and allows the cylinder to turn another quarter of a revolution, thus turning off the current. The circuit then remains open until the first tooth is brought around again, when the operation is repeated. The switch can be made to operate at more frequent intervals by placing additional teeth on the cams.

This instrument, which is designed and manufactured by Jerome Redding & Co., of Boston, was originally designed for a special use but its utility and value for many purposes was immediately recognized and there is undoubtedly an extensive field of usefulness awaiting it.

CITY ELECTRIC PUMPING FOR CHICAGO.

City Electrician Barrett, of Chicago, is having measurements taken of the various engines and pumping apparatus in the different water-pumping stations throughout the city, with the idea of formulating some scheme whereby the motive power can be supplied by electricity. As soon as measurements sufficient to form a basis to work upon are submitted to Mr. Barrett, the matter will be taken up with Mayor Swift and plans drawn and estimates made as to the probable cost of the change in the system.

THE MOST NOTABLE ADVANCE.

Mr. Arthur J. Farnsworth, electrical engineer, Mamaroneck, N. Y., writes: "I believe that the advent of the Data Sheets constitutes the most notable advance that has ever been made in technical journalism."

Power Transmission.

THE EFFICIENCY OF WORM GEARING CONNECTED TO ELECTRIC MOTORS.

In a paper read before the Electrotechnical Society of Vienna, Mr. Ernst Egger described, with the aid of illustrations, various kinds of electrically-operated elevators. The author stated that when worm gearing was employed for transmitting the power direct from the motor shaft to the drum, it was particularly advantageous to use low speed motors. This expression of opinion has elicited a response from Mr. Emil Kolben, of the Oerlikon Engineering Works, who flatly contradicts that assertion in the *Elektrotechnische Zeitschrift* of August 15th.

In correcting this erroneous idea, which has generally been held, Mr. Kolben states that high speed motors should be exclusively adopted in conjunction with worm gearing, if the work is to be commercially practicable, and a good efficiency realized. It is from this standpoint that the question is of importance to electrical engineers, since, although no particular difficulties are met with in the construction of motors to run at low speeds, yet the motors are heavy, bulky and expensive, so that the use of such motors in many cases is excluded. As, on the one hand, the employment of worm gear is regarded with great mistrust, and yet, on the other, this kind of gear is the most important reducing mechanism for electrically-driven tools, cranes and lifts, and for vehicles, Mr. Kolben thinks it right that some facts should be adduced for the benefit of the electrical industry.

Proceeding to deal with this question, the author points out that a great prejudice against worm gear has hitherto existed, on account of its having been regarded in the old text and hand-books as an inefficient means of transmission; and not unjustly so, when the method of constructing the gear is considered. After referring to the work in this direction by Profs. Thurston and Kimbal and Mr. Towne in the United States, and by the late Mr. A. Reckenzaun, who obtained an efficiency of 87 per cent., and subsequently by Mr. Sellers, in Philadelphia, the author discussed the efficiency tests recently carried out by Prof. Stodola, of the Zurich Polytechnic, with the ordinary double thread worm gear of the Oerlikon Engineering Works.

The worm was 80 mm. in diameter, had a multiple ring bearing and engaged with a worm wheel having 28 teeth, the wheel being of bronze, 373 mm. in diameter. The whole of this gear was placed in oil in a cast-iron box. The gear was coupled to a 20-H. P. electric motor, and the brakeing tests were made on the worm wheel shaft. The results were as favorable as in the case previously mentioned. At 1,500 revolutions, a useful performance of 21 H. P. was given on the brake, the efficiency amounting to 87 per cent. The author, who had previously conducted a series of experiments which agreed with the result above cited, is of opinion that the efficiency with the motor fully loaded, will increase even beyond 90 per cent., if the following points are considered in the construction and fitting up of the gear for direct coupling with electric motors.

1. The starting speed should, according to the output, amount to from 6 to 12 metres per second, instead of from 5 metres to 3 metres, as has hitherto been customary. This condition necessitates the use, not only of high motor speeds, but also of a large diameter of worm, and consequently great distances between the teeth, powerful teeth, and ample bearing surface. By this means the total friction will be reduced. For the purposes mentioned the motors required range from 2 H. P. to 25 H. P., with usual speeds varying between 1,600 to 800 revolutions a minute. As the elevator drums to be operated, the driving spindles of machine tools, and the car axles of tramcars, have speeds of from 150 to 40 revolutions a minute, it is possible to obtain in the most simple manner, without any intermediate gear, the whole speed reduction by means of worm gearing, with a single or double thread worm having a ratio of reduction of 10 to 1 or 20 to 1.

2. The mechanical production of worm gear requires the greatest care, if it is to be useful for the direct coupling of motors. The worm must be turned out of a solid piece of tool steel, and be tempered, smoothed and polished. The crown of the teeth should be made of hard phosphor bronze, and if of large diameter, it should be drawn hot on to a cast-iron arm crown. The teeth are to be properly cut and polished. The whole gear is to be enclosed in a box and allowed to work in an oil bath. This arrangement will reduce the friction coefficient between steel and bronze from 0.01 to 0.005. Gear constructed in this manner runs noiselessly, has only a slight wear, and a life of several years.

3. In order to reduce to a minimum the friction of the whole mechanism on the starting of motors at full load, the pressure is taken up by starting discs arranged on both ends of the worm.

ELECTRIC POWER FOR SANTA ROSA, CAL.

A plan is on foot to utilize electrically the water power near Santa Rosa, in the canyon near Healdsburg. It is estimated that from 2,000 to 5,000 H. P. can be developed initially, and 10,000 H. P. ultimately. The distance is 17 miles.

LAKE MAY POWER FOR LEE, MASS.

A special dispatch of Aug. 26 from Lee, Mass., says: The initiative steps are being taken by parties interested to procure the water privileges on the Lake May stream, form a stock company and put in a $75,000 electric power plant that will run some 18 or 20 mills and factories in Central Berkshire. The following firms are interested: Smith Paper Company, Eaton, May & Robbins Paper Company, Hurlbut Paper Manufacturing Company, and the following paper firms: Benton Bros., G. K. Baird & Bro., Eaton, Dikeman & Co., Forest Mills, and the other investors are Clark & Spencer's, Dowd's and McLaughlin Machine Shops, and a number of smaller flour, wire and shoddy firms. The scheme is somewhat novel, and has not been tried in New England before, though it has worked successfully in Nevada and California. The lake, which is high in the mountains, is to be drawn through a conduit 18 inches at the beginning and 4 inches wide at the foot of the mountain. It will be a little over two miles long, and by the connection of a Pelton water wheel and electric machinery is expected to give a horse power exceeding 2,000, or sufficient to run all the mills within a radius of 10 miles, the power being transferred, of course, by wire.

The scheme will furnish power at one-quarter the present cost per horse power to the paper industries of the western part of the State, which are at present somewhat handicapped, because of the shortage of water in summer, and the excessive charges of freighting coal. The charges on coal are much higher than in any part of the State east of Springfield, and even in the north part of Berkshire the price is $1.50 per ton less.

A meeting of the capitalists has been held, and the scheme laid before them by Mr. Upton, an electric expert, and a committee consisting of G. K. Baird, A. W. Eaton and E. S. Rogers was appointed to see what could be done with the present owners of mill privileges on the stream. Mr. Upton says it is the only location in the State where an almost direct fall of 600 feet can be obtained, and it will be a boon to the manufacturing interests of Western Massachusetts.

TO DEVELOP POWER AT TOPEKA, KAN.

There is a gigantic scheme on foot by an eastern syndicate, says the *Topeka Journal*, to buy all the private electrical plants in the city and consolidate them under one management. The same syndicate, it is reported, intends to purchase the street car lines, and to build the lower dam, by means of which it will operate both the lights and the cars with water power. The deal has not yet been consummated, but the indications now are that it will be made. Early last spring Congressman T. E. Burton, of Cleveland, O., was in Topeka for a week. When he had gone it was announced that a Cleveland syndicate had purchased the Brush electric light plant. Congressman Burton did not represent himself alone and the syndicate which he was behind is said to be able to control almost any amount of money. W. W. Hazzard, of Cleveland, is another of the prominent members of the syndicate. This action of the Cleveland syndicate has another meaning. An attempt has been made to get these same gentlemen interested in the construction of the lower dam, and it is reported that the representatives of the dam company were successful, except that the syndicate has a condition attached and that is that they succeed in the consolidation of the electrical companies in Topeka.

The reason of this is evident. If they had control of the electrical plants in the city they could secure their supply of electricity from the power house at their own dam and thus operate their plants at a small expense. So that if the syndicate succeeds in the purchase of the plants in Topeka they will also build the lower dam.

The Cleveland syndicate also includes the gas plant in their designs and it will also be purchased if the plan is successful. J. B. Bartholomew is the man who is now manager of the Brush plant, and he is representing the interests of the Cleveland capitalists, and that fact adds to the probable truth of the report that if the syndicate succeeds in purchasing the electrical plants they will also build the lower dam.

UTILIZATION OF THE LACHINE RAPIDS, MONTREAL.

It is over a year since the Lachine Electric Lighting corporation received water power privileges at Lachine Rapids from the Dominion government for the purpose of generating electric current and transmitting it to the city of Montreal. After incorporation on a two million dollar basis the next move was the acquirement of land at the site of the magnificent water power. That matter has been attended to and a splendid site has been chosen that will meet all the exigencies and requirements for many years to come.

Financial matters and stock takers were the next affairs to be looked after and for that purpose it is evident, says the Ottawa, Ont., *Free Press* of Aug. 23, that the management of the corporation has been keeping its eye on Ottawa. Yesterday Mr. McLea Walbank, of Montreal, arrived at the Russell and

was assigned a room next to that occupied by Mr. G. B. Burland. This morning the news was around among the financial men of the city, that G. B. Burland had taken shares to the extent of $50,000. This forenoon Mr. R. M. Cox, the millionaire timber merchant of London and Liverpool who by reason of his recent heavy investments in Ottawa and Canadian affairs, and his annual half year's stay with us may be safely considered one of us, was closeted with Mr. Walbank for a couple of hours, and the news spread around with equal rapidity to the former case, that he also was a shareholder carrying a large sized amount of stock which is universally believed to be $30,000.

POWER FROM THE SAN LORENZO RIVER, CAL.

News has reached Santa Cruz from San Francisco that Mr. Fred W. Swanton has made terms with Henry Cowell for the purchase of his water rights on the San Lorenzo river, and that if sufficient co-operation from the citizens can be secured, there is a possibility of placing an electric power that will give Santa Cruz a boom in locating minor manufacturing establishments and make light, heat and power cheap.

POWER AT STEVENS POINT, WIS.

Stevens Point is figuring on making use of its water power to generate electricity for the running of machinery in the city. It is claimed that the water power is sufficient even in low stages to furnish 1,500 horse power. Primarily, it is to run the water and light works and the electric street cars, but incidentally, it will furnish power wherever it is wanted. They claim that it can be furnished at a cost of $30 per horse power per year while steam costs $50. Then it will save on insurance and be ready for use without firing up and be used only in such quantities as may be wanted. This is eminently practical. They certainly have an immense power going to waste which can be distributed all over the city very cheaply.—*Milwaukee* (*Wis.*) *Journal.*

MISCELLANEOUS.

SCIENTIFIC USES OF LIQUID AIR.—IV.

BY PROF. J. DEWAR, F. R. S.

(*Concluded.*)

A second series of experiments were made with a set of cast test pieces of metals and alloys. The test pieces, all cast in the same mould, were 2 in. long with ½in. spherical ends, the cylindrical portion being two-tenths of an inch in diameter. The spherical ends of the test pieces rested in similar cavities made in a special set of steel supports that fitted on to the testing machine. Crystalline metals give castings that are far from uniform one with another, and it is very difficult to get even comparable results with methods like zinc, bismuth and antimony. The following table gives the experimental results:—

TABLE II.

BREAKING STRESS IN POUNDS OF CAST METALLIC TEST PIECES. DIAMETER OF ROD 0.2IN.

—	15°C.	– 182°C.
Tin	200	390
Lead	77	170
Zinc	35	26
Mercury	0	31
Bismuth	60	30
Antimony	61	30
Solder	300	645
Fusible metal (Woods)	140	450

It will be noted that in this list the breaking stress, by cooling to —182° C., has been increased to three times its usual value in the case of fusible metal, and to twice its usual value in the case of tin, lead and solder. The results with zinc, bismuth and antimony are exceptional, seeing they appear to be diminished in tenacity. This, however, may be only apparent, because the stresses set up in cooling such highly crystalline bodies probably weaken some set of cleavage planes so that rupture is then comparatively easy. In any case is must be admitted that no reliance can be placed on the tenacity of highly crystalline metals. The breaking stress of mercury is interesting, and turns out to be at —182° C. nearly half that of lead at the ordinary temperatures.

The percentage elongation is not given in the foregoing tables, simply because the value of such measurements is of little importance when such short pieces of the metals are under observation. The general results of such observations are, however, interesting; thus, lead and tin at ordinary temperatures elongate before breaking about the same amount, whereas if tin is cooled to —182° C. it hardly shows any extension, and lead under such conditions shows no change, stretching as much at —182deg. as at 15° C. Solder and fusible metals stretch less, and the cross-section of the break is much less at —182deg. than at 15° C.

The above experiments can only be considered as preliminary to a more elaborate investigation of the actual variation of the elastic constants at low temperatures. It will require complex experimental arrangements to get reliable measurements of the Young modulus and the rigidity modulus at the temperature of boiling liquid air. In the case of fusible metal, a first attempt to compare the ratio of the Young modulus at 15 deg. and —182 deg. with the ratio of the rigidity modulus between the same limits of temperature, has resulted in finding that both constants are increased in the same proportion. From this it would follow that the resistance to compression of the substance at —182° C. must be increased in a similar ratio. The comparative behavior of strong steel spirals at 15° C. and —182° C. as to their elongation on the repeated addition of the same load was a subject examined on several occasions. The most careful comparison of such spirals, however, revealed no measurable differences in their elongation between the ordinary temperature and that of boiling oxygen. This may be due to the want of sufficient sensibility in the testing machine when applied to such delicate experiments. In the meantime it is reasonable to conclude that the rigidity modulus of very hard steel is not much changed by cooling it to —182° C. If balls of iron, tin, lead or ivory are cooled to —182° C. and dropped from a fixed height on a massive iron anvil the elastic rebound is markedly increased in all cases. The flat distortion surface produced on the lead sphere after impact is only one-third the diameter of the circular surface produced at the ordinary temperature when the lead ball falls from the same height.

The examination of the magnetic condition of matter at low temperatures is a subject of great interest and offers a wide field for investigation. In a former lecture the magnetic properties of liquid oxygen and air were discussed. Owing to the experimental difficulties, accurate quantitative measurements of the permeability have not yet been successful. Faraday was the first experimenter who examined the magnetic condition of matter at the lowest temperature that could be commanded in his time, viz., about — 110° C. He did not succeed in making any substance which was non-magnetic at ordinary temperatures assume the magnetic state at the lowest temperature of the solid carbonic ether bath in vacuo. Later experimenters have directed their attention more especially to the action of high temperatures on magnetism, and the work of Profs. Hopkinson and Ewing in this field of research is well known. Prof. Trowbridge examined the effect of a temperature of — 80° C. on a permanent magnet, and came to the conclusion that the magnetic moment was diminished by about 50 per cent. Prof. Ewing found that an increase of temperature of 150° C. above 10 deg. caused a reduction of the magnetic moment of a bar magnet by about 40 per cent., and that the magnet on cooling recovered its original state. This result would lead us to expect that if the same law is followed below the melting point of ice as Ewing found above it, then a bar magnet cooled to — 182° C. ought to gain in magnetic moment something like 30 to 50 per cent. The experiment of Prof. Trowbridge is, however, apparently opposed to such an inference. It appears however, that Prof. Trowbridge cooled a magnet that had not reached a constant state (that is to say, one that on heating would not have completely recovered its magnetization on cooling), because after the magnet had been cooled to — 80 deg. on regaining the ordinary temperature, it had lost 50 per cent. of its original magnetic moment. Such a magnet would apparently diminish in magnetic moment on cooling and heating the first time the action was examined, but a repetition of the process when the action of magnetization and temperature were strictly reversible might lead to an opposite conclusion. To settle this question a series of experiments on the magnetic moment of small magnets cooled to — 182 deg. were carried out. Small magnets from half an inch to an inch in length were made of watch-spring or steel wire, and were either used separately or in bundles; they were fixed rigidly in a block of wood by means of copper staples, and in this condition were easily clamped firmly in the field of a magnetometer. The cooling was effected by applying a cotton-wool sponge of liquid air. The relative deviations of the magnetometer are proportional to the magnetic moment of the magnet under the respective conditions of + 15° C. and —182° C. After the first cooling the magnet is allowed to regain the ordinary temperature, and the operation of cooling and heating is repeated three or four times. The following table gives some of the results, and these may be taken as typical of a large additional number unrecorded.

If the experiment marked (1) is examined we find cooling to — 182 deg. in the first cycle produced no change of magnetic moment, but that on heating to +15° C. the magnet had lost 30 per cent. of the original strength. In the second cycle cooling increased the magnetic strength of the magnet in the condition in which it is left after the first cooling by 33 per cent., and heating

diminished it by 5 per cent.; whereas in the third cycle cooling showed 36 per cent. increase, and no loss in heating. It was only after three alterations of temperatures from +15° C. to —182° C. that the magnet reached a steady condition. In experiment (3) the first cooling shows a loss of 24 per cent., while in experiment (4) the first cooling shows a gain of 12½ per cent.

CHANGE OF THE MAGNETIC MOMENTS OF PERMANENT MAGNETS AT +15° C. AND —182° C. PER CENT. OF THE VALUE AT THE BEGINNING OF EACH CYCLE, WHICH IS ALWAYS 15 DEG.

——	— 182° C.	+15° C.
(1) Hard steel, 0·5in. long and 0·4in. diameter		
First cycle	+ 0	— 30·0
Second "	+33·0	— 5·0
Third "	+36·0	0
(2) Soft steel.		
First cycle	+12·0	— 23·0
Second "	+51·0	0
Third "	+51·0	0
(3) Hard steel, 1·03in. long, 0·4in. diameter.		
First cycle	—24·0	— 43·4
Second "	+23·0	0
Third "	+23·0	0
(4) Nine steel wires in bundle.		
First cycle	+12.5	+ 3·0
Second "	+33·0	— 2·0
Third "	+33·0	0
Tested four days after.		
First cycle	+50·0	0

It is clear, therefore, that according to these experiments, every magnet has individual characteristics that may either result in no change on cooling or the addition or subtraction of from 12 to 24 per cent. in the magnetic strength. All the experiments, however, show that a repetition of the cycle of heating and cooling brings the magnet to a steady state, in which cooling always causes increase in the magnetic strength of from 30 to 50 per cent., and the re-heating brings about no loss in the original magnetic moment. Such a marked alteration in magnetic strength might be used as a thermometer in low temperature research, and it is my intention to extend the inquiry to the lowest temperature that can be reached by the evaporation of nitrogen in vacua. A simple mode of showing the sudden alteration of magnetic strength on cooling is to surround a permanent magnet made up of a bundle of steel wires with a coil of copper wire, leaving the ends of the magnet to project so that they can be dipped in liquid air. When the copper wires are attached to a galvanometer, and one of the ends of the magnet cooled, an induced electrical current occurs, due to the sudden magnetic change. Accurate observations must be made on the permeability and susceptibility of the magnetic metals at the temperature of boiling liquid air, and the above results are an indirect guarantee that this field of investigation will be fruitful in new scientific facts.

This lecture has already covered a very wide field. It is easy to put into a Friday evening discourse the work of a year. Members and friends have chiefly contributed to the research fund, which has enabled the Institution to extend the experimental plant needed for the prosecution of research in this field of inquiry, and they have strong claims to learn, in the first instance, the results of the general laboratory work. My object has been to illustrate the scientific uses of liquid air. To do this with any satisfaction requires what may be called a good deal of scientific prospecting. Is is one thing to discover where the ore lies, it is another thing to produce the refined metal. Investigations on the properties of matter at the temperature of boiling liquid air, must be in the first instance rather qualitative than rigidly quantitative. In my opinion, scientific progress is best served by conducting the inquiry on these lines. It will be easy to refine later on.

I have to acknowledge the great assistance I have received in the conduct of these experiments from my excellent chief assistant Mr. Robert Lennox, and I must also express commendation of the way Mr. Heath has helped in the work.

TEST OF ALUMINUM IN SEA WATER.

SOME months ago two plates of aluminum were sent to the Norfolk Navy Yard to be tested as to their ability to resist the action of salt water. One of them was pure aluminum, weighing 2 pounds 9 ounces; the other contained six per cent. alloy of copper. They were immersed for forty-five days, and at the end of that time the plate of pure metal was found to be only slightly affected, and the aluminum wire by which it was suspended was perfectly intact. It had lost half an ounce in weight. The alloy plate was found to be corroded and roughened over its entire surface, the wire by which it was suspended was eaten entirely away, and it had gained half an ounce in weight by corrosion.

The plates were again immersed, this time for three months. The report of this test, recently received at the Navy Department, says that the pure plate was slightly roughened over its entire surface, and that there were a few barnacles attached. After being cleaned it was found not to have changed in weight. The alloy plate was found covered with barnacles and corroded to a greater degree than the plate of pure aluminum. It was not weighed.

A practical test was made of aluminum in the construction of small boats by Mr. Walter Wellman, who had three constructed to carry his polar expedition last year. These boats, it is said at the Navy Department, have been brought back to Washington, and an examination made some time ago showed that the material had so deteriorated that it could be easily crumbled in one's hand.

ACTION OF THE ELECTRIC CURRENT ON FUSED SULPHIDES.[1]

BY JULES GARNIER.

AFTER having determined that carbon, heated to redness under the influence of an electric current of feeble voltage, is transported from the positive to the negative electrode, which fact permitted me to indicate a new method of iron cementation, I thought that this action of an electric current ought not to be limited to carbon. To determine this fact, I made experiments in the laboratories of M. Hillairet. I employed a tube of refractory material placed horizontally in a reverberatory furnace, and receiving the matter to be electrolized between the two electrodes in the heated part of the tube. The current was furnished by a Gramme machine. I operated it first on a raw nickel matte from Sudbury, Ontario. I placed a certain quantity of it in the middle of the tube between the two carbons. The spaces between the carbon rods and the walls of the tube were filled with refractory earth mixed with charcoal, to guard against the intrusion of oxygen, but not the exit of gas under feeble pressure which is formed during the electrolysis, and which can thus escape by the cracks which the heating produces in the clay mass. The matte being melted, I passed a current of 10 volts and 23 amperes; the current only showed feeble oscillations according to the voltmeters, proving that there was a great regularity in the conductibility of the molten mass. Moreover, the voltage was gradually lowered, although the temperature of the reverberatory furnace was almost constant, which went to prove that the nature of the mixture was changed. After an hour of heating, slow cooling and stoppage of the current, I opened the tube. The positive carbon rod was worn to a feather edge at its upper end, while the negative rod remained intact. Of the matte an analysis was made of those parts which were solidified at the point of contact of the two electrodes. Only the insoluble parts which existed in fragments of the walls of the tube strongly attached to the matte, even after cooling, were eliminated from the samples. Of the analyses given below, No. 1 is of the matte taken; Nos. 2 and 3 are respectively those of the material in contact with the anode and of the cathode after the electrolysis, and No. 4 shows an average of Nos. 2 and 3.

	(1)	(2)	(3)	(4)
S%	21.10	16.60	4.70	10.65
Fe%	33.30	35.40	49.10	42.30
Ni%	16.30	5.18	19.10	12.14
Cu%	29.00	39.90	26.13	33.02
	99.70	99 20	99.03	98.11

These analyses show that 50% of the sulphur is eliminated, which sulphur keeps with the copper, especially near the anode; that the iron remains near the cathode, where it seems to accumulate according to the average analysis, No. 4; that the nickel regularly increases in quantity from the anode to the cathode, and the copper diminishes in a regular arithmetical progression from the anode to the cathode. I think that one may conclude from the results of the above experiment that (1) the sulphur combined with the metals in the molten state, in the absence of air, when traversed by an electric current (the electrodes, at least, the anode, being of carbon), is gradually eliminated in the form of sulphide of carbon; (2) in a mixture of molten metallic sulphides, in the absence of air, traversed by an electric current, the electric conductivity of the mixture remains homogeneous at every moment, increasing little by little on account of the gradual elimination of sulphur; the metals and the remaining sulphur arrange themselves in such a way that each elementary section of the bath taken perpendicularly to the direction of the current, has the same electrical conductivity; thus the copper, a better conductor than iron or nickel, keeps the greatest portion of the sulphur, so that its conductivity may be reduced in the desired proportion.

It is possible, I think, from the above experiments, to explain certain observed phenomena; for example, the mode of distribution of the metals free from, or combined with, sulphur in veins.

1. Comptes Rendus.

ELECTRIC FURNACES AND THEIR APPLICATION TO THE TRANSFORMATION OF CARBON INTO GRAPHITE.[1]—I.

BY CH. STREET.

The honor of reading this Paper belonged of right to my colleague M. Charles Girard, and I have to thank him for having allowed me to give you an account of our labors.

Before describing our methods of transforming carbon into graphite, methods which are founded upon the employment of special electric furnaces, we thought it would be a good thing to review for your benefit the interesting attempts that have been made in the direction of applying electricity to metallurgy, by making use of the extremely high temperatures placed at our disposal by the electric current. We thought it appropriate for the Société Internationale des Electriciens to record the results obtained, in order that it might assist progress towards the distant goal which we shall certainly reach in the future. The limited scope of this communication and the fear of tiring you by a too detailed *exposé* obliged me to limit the number of inventions to which I shall call your attention.

Apparatus in which heat is produced by means of electricity

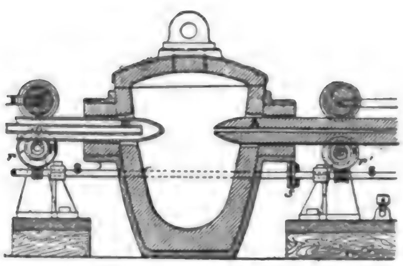


FIG. 1.

may be divided, like electric lighting apparatus, into two large classes; some furnaces are based on the incandescence of a resisting portion of the circuit, the others on the use of the electric arc. The latter are those which enable us to obtain the most powerful effects and which it would seem are destined to yield the most valuable results.

The International Electrical Exhibition of 1881 acquainted us with the two first electric furnaces which may be regarded as the starting point of all apparatus of the kind. The apparatus exhibited by Messrs. Siemens consisted of a carbon crucible heated by an electric arc in the interior (*see* Fig. 1). The carbon crucible containing the substance to be heated had two apertures through which the electrodes passed. A carbon lid enclosed the contents. The electrodes were either both of carbon or the positive was of carbon and the negative was of metal and kept cool by circulating water. The electrodes were fed forward automatically as they

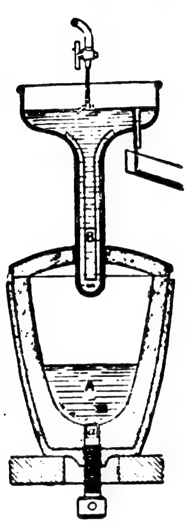


FIG. 2.

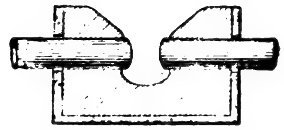


FIG. 3.

were consumed by means of a device which I will not stop to describe. The Siemens electric furnace could be arranged in another way when the material in the crucible was a good conductor of electricity. The current was brought to the bottom of the crucible by a platinum screw *a* (Fig. 2) and transmitted to the conducting substance A, which was thus placed in connection with the positive pole. An arc was established between A and the negative pole B, which was cooled by circulating water.

The second piece of apparatus to which I will allude is that of our colleague M. Louis Clerc. This consisted of a block of magnesia or carbonate of lime (Fig. 3), in which a cavity was hollowed out where the arc played. The electrodes consisted of two 20mm. carbons. In this furnace its inventor volatilized silica and lime.

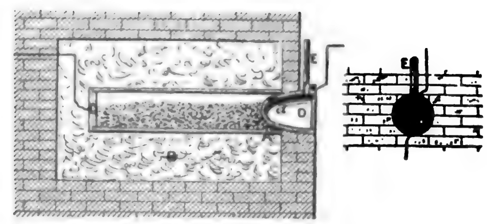


FIG. 4.

If my memory serves me aright M. Clerc, who publicly repeated his experiments every evening before the visitors to the Exhibition, sent M. Daubrée some very curious specimens of crystalline lime, products of the condensation of the substances volatilized in his furnace.

In 1885 Messrs. Eugene and Alfred Cowles took out a patent for an electric furnace which was the starting point of their interesting work on the production of aluminum. In this furnace the heat was produced by bringing the material to be treated to incandescence by means of the electric current, the charge being previously pulverized and mixed with powdered retort carbon (Fig. 4). The first apparatus which was made was intended for the reduction of zinc ores, and its use was extended to the reduction and fusion of other ores, especially aluminum, silicium, magnesium, and boron ores. This furnace consisted of a cylinder A, made of silica or any other non-conductor of electricity. This cylinder was surrounded with powdered charcoal B, or any other bad conductor of heat. One end of the retort was closed by a plate of carbon C, which formed the positive electrode. The other end was closed by a graphite crucible D, which formed the negative electrode. This crucible, at the same time as it served as a negative electrode, formed a gas-tight plug for the retort and a condenser for the zinc vapor. The charge, a mixture of ore and carbon, was introduced through the aperture closed by the crucible.

1. Paper read before the Société Internationale des Electriciens.

NEWS AND NOTES.

REPORTING THE INTERNATIONAL YACHT RACE FROM MID-OCEAN.

General Manager Ward and his colleagues of the Commercial Cable Co., as well as the staff of the Postal Telegraph Co., made a great hit on Saturday last by running out a special cable to the scene of the great initial race between the "Defender" and the "Valkyrie III." The "Mackay-Bennett" cable steamer with 14 miles of Siemens cable, hitched on to the Commercial Cable system, through its Coney Island shore end, and then ran out to the Sandy Hook race course. On board the moving steamer was a corps of telegraph operators, an office was thus set up in mid-ocean, and all the world, including New York, got the news of the progress of the race and the victory of the "Defender," instantaneously. It was a big idea and a brilliant success. The work is to be repeated each race day, and the "Mackay-Bennett" will carry the usual day and night cable laying signals.

ELECTRIC ELEVATOR WANTED FOR PARIS, TEXAS.

The Treasury Department, through the Office of the Supervising Architect, is inviting proposals until September 20, for furnishing and erecting, complete, an electric elevator (passenger) for the United States Court House and Post Office Building at Paris, Texas.

Respective bidders may address for further particulars, Hon. H. R. P. Hamilton, Acting Supervising Architect, Treasury Department, Washington, D. C.

TAXING POLES IN DAVENPORT, IA.

Each pole in Davenport is to be taxed 50 cents a year, and the City Electrician, Mr. Goldschmidt, estimates that the 5,000 poles in town can be reduced 20 per cent., an end that the tax will materially assist. The city electrician now has supervision also of all inside wiring.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED SEPT. 3, 1895.

Alarms and Signals:—

Railway Block Signal System, A. W. Hall, New York, 545,494. Filed June 15, 1895.

Electric Signaling Apparatus, J. H. Fildes, Chicago, Ill, 545,469. Filed June 12, 1895.
Consists in means for controlling the transmission of the signal actuated by a passing locomotive-engine or train.

Signal Box, N. H. Suren, New York, 545,689. Filed Mch. 6, 1895.
Increases the length of the stud on the outer door which operates the non-interfering plunger by making such stud telescopic in construction. Improvement on the Gardiner system.

Electric Alarm, W. S. Hull, Dallas, Texas, 545,658. Filed Nov. 26, 1894.
A special form of relay.

Semaphore Signal for Railways, J. W. Lattig, West Bethlehem, Pa., 545,701. Filed Jan. 5, 1895.
The semaphore carries a number of incandescent lamps which are illuminated in rapid succession by means of a revolving switch.

Indicator, B. F. Rittenhouse, Philadelphia, Pa., 545,736. Filed Apl. 13, 1895.
The push button encloses a coil with vibrating core the sound of which indicates the integrity of the circuit.

Electric Signaling Apparatus, B. Price, Baltimore, Md., 545,815. Filed April 24, 1894.
A device for sending a fixed combination of electrical impulses over the line and a receiving device for selecting the signals.

Electrical Burglar Alarm, J. R. Alexander, New Albany, Ind., 545,835. Filed March 20, 1895.
Wires are run through grating bars which protect a window; the alarm is sounded when the grating is disturbed.

Conductors, Conduits and Insulators:—

Cleat for Electric Wires, M. M. Wood, Chicago, Ill., 545,690. Filed Jan. 11, 1895.
In a cleat for electric wires, a body having a slot, the opening of which is substantially parallel or in line with the length of the wire, and which is curved within the cleat so as to form a hump or bend on the wire to prevent its longitudinal motion.

Electric Insulator, D. M. Rithenberger, Lancaster, Pa., 545,819. Filed March 8, 1895.
The insulator is provided with a transverse ligament around which the tie-wire is passed, the said wire then being twisted around the main wire.

Distribution:—

Electric Transformer, W. F. Brittin, Allegan, Mich., 545,670. Filed Nov. 16, 1894.
Relates to the form of the laminated core and the arrangement of the windings, the secondary being placed between portions of the primary.

Dynamos and Motors:—

Electric Motor, J. O'Neil, New York, 545,524. Filed June 2, 1894.
The armature has three poles revolving in a two pole field.

Alternating-Current Generator or Motor, E. Thomson, Swampscott, Mass., 545,554. Filed Sept. 29, 1891.
A field magnet and an armature magnet having a series of coils and the other having its poles subdivided into separate polar projections spaced according to the scale of spacing of the poles for the first.

Electric Coal or Rock Drill, H. H. Bliss, Washington, D. C., 545,570. Filed Sept. 6, 1888.
Details relating to a motor designed for strength and compactness.

Electric Motor, O. E. H. Kramer, St. Louis, Mo., 545,591. Filed Apl. 23, 1894.
Details of construction of a multipolar motor.

Electric Motor, O. E. H. Kramer, St. Louis, Mo., 545,593 Filed May 10, 1894.
Details of construction relating to two motors coupled to the same shaft.

Method of and Apparatus for Controlling Currents for Electric Motors, T. Von Zweigbergk, Cleveland, Ohio, 545,664. Filed Nov. 1, 1894.
A car controller with special devices for shortening the duration of the arcs by dividing the contact spaces.

Asynchronous Motor, M. Hutin & M. Leblanc, Paris, France, 545,698. Filed Apl. 19, 1895.
The method of starting and running single phase alternating current motors in either direction, which consists in rotating in the direction to be given to the armature and between the same and a circular row of alternately wound field magnets, a flux screen containing circuits closed upon themselves, and passing single phase alternating currents through the field coils.

Rotary Field-Motor, A. E. DuBois-Reymond, Berlin, Germany, 545,853. Filed Dec. 26, 1893.
In a rotary current motor the combination with a number of coils each connected at intermediate points with a number of contact terminals, said contact terminals being arranged in a circle, of a number of brushes, one for each coil, mounted to be moved over said terminals and adapted to make contact with corresponding terminals of the several coils whereby the effective lengths of the several coils may be varied at will.

Electric Tool and Machine, H. H. Bliss, Washington, D. C., 545,569. Filed Dec. 24, 1886.
A motor arranged to drive a boring bar. Intended for mining work.

Lamps and Appurtenances:—

Electric Arc Lamp, R. H. Jahr, Opladen, Germany, 545,694. Filed Nov. 26, 1894.
Consists in an auxiliary resistance determining the current flow through the regulating-helix and a connection between this auxiliary resistance and the main regulating resistance of the lamp, whereby both these resistances are caused to move in conformity with the current intensity and current tension necessary for the degree of brilliancy desired.

Electric Arc Lamp, R. Segerdahl, Chicago, Ill., 545,736. Filed Apl. 26, 1894.
Relates to a double lamp of the type in which the carbons are normally kept apart until the current is turned on.

Carbon Holder for Electric Arc Lamps, T. E. Adams, Cleveland, O., 545,755. Filed Feb. 15, 1895.

Adjustable Support for Electric or Other Lamps, L. Goddu, Winchester, Mass., 545,485. Filed Mch. 30, 1894.

Miscellaneous:—

Electric Igniting Apparatus for Gas Engines, H. Thau, New York, 545,553. Filed Oct. 20, 1894.

Electric Time Check Receiver, C. K. Jardine, Georgetown, British Guiana, 545,696. Filed March 26, 1895.

Electrical Annunciating-Target, O. Kauffmann, Sacramento, Cal., 545,699, Filed Nov. 15, 1894.

Railways and Appliances:

Support for Overhead Electric Conductors, M. Hanford, Malden, Mass. 545,495. Filed April 25, 1894.
A trolley wire connector.

Trolley Guard, J. T. Moody, W. Shawd and A. J. Baker, Springfield, Ohio, 545,520. Filed Feb. 23, 1895.

Trolley Arrester, H. F. Hildebrandt, Rochester, N. Y., 545,649. Filed May, 6, 1895.
Automatically arrests and controls the trolley arm when it becomes disengaged from the line-wire and brings it into a position where it can do no harm.

Trolley, Z. T. Furbish, Augusta, Me., 545,686. Filed July 12, 1895.
Details of construction.

Trolley-Wire Support, J. W. Meaker, Evanston, Ill., 545,806. Filed Nov. 17, 1894.
Consists of a clip of thin sheet metal held in position by a wedge.

Bond for Electric Railways, E. S. Wheeler, Saugatuck, Conn., 545,833. Filed Jan. 14, 1895.
A chair with a flange and a draw bar engaging with the opposite faces of the webs of the rails.

Electric Brake, W. L. Hedenberg, New York, 545,496. Filed May 7, 1894.
A controller is arranged to throw one or more coils into circuit at a time, whereby the shoes will advance towards the wheels to apply the brake with more or less force.

Switches, Cut Outs, etc.:—

Safety Appliance for Electric Conductors, A. E. Hutchins, Detroit, Mich., 545,629. Filed May 5, 1893.
An automatic cut-out put in operation by the sagging or the breaking of a wire.

Telegraphs:—

Telegraph Key, G. F. Philbrook, Lisbon Falls, Me., 545,532. Filed Jan. 19, 1895.
A weighted and pivoted button arranged to fall when the operator's finger leaves it, and provided with a contact-piece which closes the circuit.

Teletyper, C. Spiro, New York, 545,637. Filed Dec. 18, 1894.
An arrangement by which a typewriter can be used for transmission or for regular office work.

LEGAL NOTES.

SOME LIGHT ON THE OLD WESTERN UNION-AMERICAN BELL ROYALTY LITIGATION—A FAVORABLE BELL DECISION.

In the United States court of appeals, at Boston, last week, a decision was rendered in the case of the American Bell Telephone Company, appellant, vs. the Western Union Telegraph Company, et al., complainants, appellees, in favor of the appellant.

This suit, which was originally brought in the circuit court by the Western Union Telegraph Company, the Gold & Stock Telegraph Company and the American Speaking Telephone Company, and continued by the Western Union Company, was for an accounting from the Bell Company alleged to have been the right of the plaintiffs under certain contracts made by them with the Bell. (See the contract in THE ELECTRICAL ENGINEER, Aug. 28.)

The contracts gave the Bell Company the right to use certain inventions for the transmission of messages that were owned by those companies, the Bell Company agreeing to pay certain royalties. The plaintiffs claimed there was a large sum due them for royalties, and this the Bell Company denied. After the case was begun in court, hbot sides made a stipulation referring the case to Hon. John Lowell as master, "to hear the parties, report the facts and his rulings on any question of law arising in the case" to be taken.

The master heard the parties, and decided what his decision upon the facts and law would be, and communicated them to the counsel. Afterward he filed his report in the clerk's office, whereupon the Western Union Company, et al., the decision of the master being against them, moved the circuit court to allow them to dismiss their bill without prejudice to the bringing of another action for the same cause.

That court did allow them to have their bill dismissed without prejudice, whereupon the Bell Company took this appeal, claiming that at that stage of the case the lower court had not the right to dismiss the bill.

The court of appeals holds that the contention is right. W. G. Russell and J. J. Storrow for appellant; J. H. Benton, Jr., for appellees.

SIEMENS-HALSKE RAILWAY LITIGATION.

THE Siemens-Halske Electric Co. has sued the Metropolitan Elevated Railroad Co. of Chicago, for infringement of its third rail system put in by the General Electric Co., and has asked for an injunction.

THE TESLA PATENTS.

THE Westinghouse Electric and Manufacturing Co. has issued a circular directing attention to its Tesla patents, under which it is suing the General Electric and Stanley Cos., and asserting that these patents control all the developments of polyphase and multiphase working, both for lighting and for power.

"RELATIVE to the Data Sheets which you are publishing, I take great pleasure in adding my statement to that, doubtless, of all who have the privilege of receiving them, that they are of great value both as to the matter and as to its method of presentation."

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE QUAKER CITY DYNAMO AND MOTOR.

THE accompanying engraving illustrates the new dynamo and motor just brought out by the Quaker City Electric Co., of Philadelphia. This machine has been designed to meet the demand for a high grade machine for isolated lighting plants at a low cost. The frame is made of cast steel, the commutator of tempered copper, and the insulation and other materials used

QUAKER CITY DYNAMO AND MOTOR.

throughout in the construction of the machine are of the best quality suited to the purpose. The improved self-feeding brush holder permits the machine to be reversed, a most desirable feature for elevator motors. These machines, at present built in sizes ranging up to 25 H. P., are provided with self oiling bearings and regulate automatically between full load and light load.

PACKARD TRANSFORMERS.

The Electric Appliance Company are showing a good unsolicited testimonial letter on the Packard transformer from a customer who states that he has a large assortment of transformers on his lines, scattered among which are quite a large number of Packard transformers. During a recent severe storm of lightning eight transformers of almost as many different makes were completely burned out, while the Packard transformers were not injured in any way. The manufacturers claim that the way they are building the Packard transformer now, it is practically impossible to burn it out.

CROCKER-WHEELER ELECTRIC CO.

AFTER a continuous run of one thousand hours—Sundays excluded—the Crocker-Wheeler Electric Co. have caught up with their orders, which since their fire in the spring have been doubled. They have nearly replaced, also, their stock of parts and are therefore in position now to serve their numerous customers with greater promptitude than has recently been possible. When the magnitude of the disaster that fell suddenly upon this company is remembered, the feeling of pleasure and satisfaction will be general, at the rapid and gallant rally made by this standard concern which has done so much to foster and promote the electric power industry.

THE INTERNATIONAL ELECTRIC CO. OF ST. LOUIS

There comes to hand an announcement of the location in St. Louis of another factory for the manufacture of incandescent lamps. The style of the new company as incorporated under the laws of the State of Missouri, is the International Electric Company. The location of their factory is 19th and Olive streets, St. Louis, being within three blocks of that city's new Union Station. Their factory building is modern in every respect, being five stories high and especially adapted to the work for which it is to be used. The manufacture of the incandescent lamps is in the hands of Mr. J. M. Davey, who, for some ten years has been identified with the incandescent lamp business. The new lamp now being put upon the market about September 1st will be known as the "Davey High Grade." The object of the new company is to furnish a strictly high grade lamp that will appeal for approval alike to the central station, isolated plant and trade in general. The business management is in the hands of H. G. Ferguson, who has been actively identified with several large central stations in the West and who is familiar with electrical matters both theoretically and practically.

WESTERN TELEPHONE CONSTRUCTION CO.

The Effingham, Ill., Telephone Co. have awarded to the Western Telephone Construction Co. of Chicago the contract for 100 telephones and switchboard complete. The Western Co. have also furnished the Columbus Memorial Building in Chicago with a private telephone exchange which, it is asserted, surpasses for elegance and efficiency, anything else in this country. The switchboard is mounted on an oak table with nickel plated portable telephones. Among the recent shipments have been orders for Mexico and Yokohama, Japan.

NEW YORK NOTES.

MR. J. W. GODFREY, sales manager for the India Rubber & Gutta Percha Insulating Co., returned from Europe last week on the "New York," accompanied by his family and his nephew, Mr. R. J. Simes. What Mr. Godfrey has not seen is not worth the attention of the natives.

ROCHESTER, N. Y. has had another high voltage sensation, when H. W. Sherman received 2,000 Brush volts, but, like Frank Grover, was saved by his shopmates in the station, and was restored to consciousness under the rules of immortality enforced by Supt. G. A. Redman. It is far harder to kill a man by electricity at Rochester than at Sing Sing.

THE GOULDS MANUFACTURING COMPANY, Seneca Falls, N. Y., report the following sales of their triplex power pumps: Plattsburgh Light, Heat & Power Co., Plattsburgh, N. Y., one 1¾" x 2½" triplex power pump to be operated by electric motor. Mineral Farm Consolidated Mining Co., Aspen, Col., one 6½" x 8" triplex power pump and 5 H. P. motor for operating it. Bagnall & Hilles, Yokohama, Japan, one 5" x 8" triplex power pump to be driven by electric motor.

MR. EDGAR NEWMAN, of the firm of Schminke & Newman, 321 Magazine street, New Orleans, was in New York last week, incidental to a trip through the East. This concern represent the Nuttall, Beacon lamp, Baltimore car truck, Packard converter, Backus motor, Helios lamp, Safety wire and other specialties and have built up a large and growing trade in their Louisiana territory. Mr. Newman speaks most hopefully of the outlook.

WESTERN NOTES.

MR. W. H. MCKINLOCK, president of the Metropolitan Electric Co. of Chicago, has been through the East on business.

GRIER BROS., the Western Managers of the Bryant Electric Co., of Bridgeport, Conn., have removed from 1532, the Monadnock, Chicago, to 1436 in the same building.

THE BRYANT ELECTRIC CO. are getting out a new catalogue of their well known specialties, which they expect to have ready for distribution early in September.

THE PARTRIDGE CARBON CO. of Sandusky, O., write us that their carbon brushes are coming more and more into favor every day. The sales have more than doubled during the past year.

THE STANDARD ELECTRIC CO. find it necessary on account of the large number of orders on hand and the prospects for new business, to increase their facilities. Negotiations are now under way to secure new quarters.

MR. WILLIAM S. LOVE, who is well known in electrical and engineering circles in the West, has been appointed western agent for the Abendroth & Root Mfg. Co., of New York, and will have his headquarters at their office in the Monadnock Block, Chicago.

S. F. B. MORSE, of Chicago, who, as every one knows, is the popular representative of Kerite specialties in the West, has decided hereafter to drop the "& Co." from the name of his firm, and will henceforth "go it alone." We wish him every success.

THE ELECTRIC APPLIANCE COMPANY are making a special effort on telephone line materal, and are prepared to make exceptionally low prices on copper and iron line wire, pony glass insulators, pins, brackets and cross arms; making shipment in all cases promptly from Chicago stock.

PHILADELPHIA NOTES.

THE ELECTRICAL MAINTENANCE CO. of 50 Broadway, W. J. MacConnell, general manager, has opened a branch office at 1111 Betz Building, Philadelphia, and has placed Mr. J. W. Cregar in charge.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

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THE NEW STORAGE BATTERY PLANT OF THE BOSTON EDISON COMPANY.

BY

HISTORICAL.

ABOUT three years ago Mr. C. L. Edgar, general manager of the Edison Electric Illuminating Co., of Boston, made an extended tour through Europe, during which he made a careful examination of the workings of all the chief central lighting stations where storage batteries were being used as auxiliaries. He found many such stations in successful operation, and was most favorably impressed with the advantages offered by such installations.

Appreciating that in the most completely equipped and most carefully managed plants and systems there were times and conditions ever and anon arising and to be met when an efficient and reliable auxiliary would be most valuable, as in the case of an accident to engines or dynamos, an unusual demand for current at some unexpected moment, or the necessity for securing an even balancing of an extensive lighting and power system, Mr. Edgar became strongly impressed with the value of a good storage battery plant for the purpose, and so reported to his directors on his return home.

The result was, that after completing what is known as the Third Station, situated on Liverpool Wharf, Atlantic Avenue, Boston, with a very extensive steam and generator plant, it was determined to install a battery plant as an auxiliary. They accordingly contracted with the Accumulatoren-Fabrik Aktien-Gesellschaft, of Berlin, Germany, for a battery plant of the now well known and efficient Tudor type, which for about eighteen months has been in very successful operation.

The company's business continuing to grow so rapidly, and the demands made upon the resources of what is called their Head Place Station increasing month by month, they were compelled to add to its capacity. This they did by erecting a five-story building adjoining the station and equipping it as a storage battery plant. The work now being completed and the battery in regular use, some account and description of it cannot fail to be of interest.

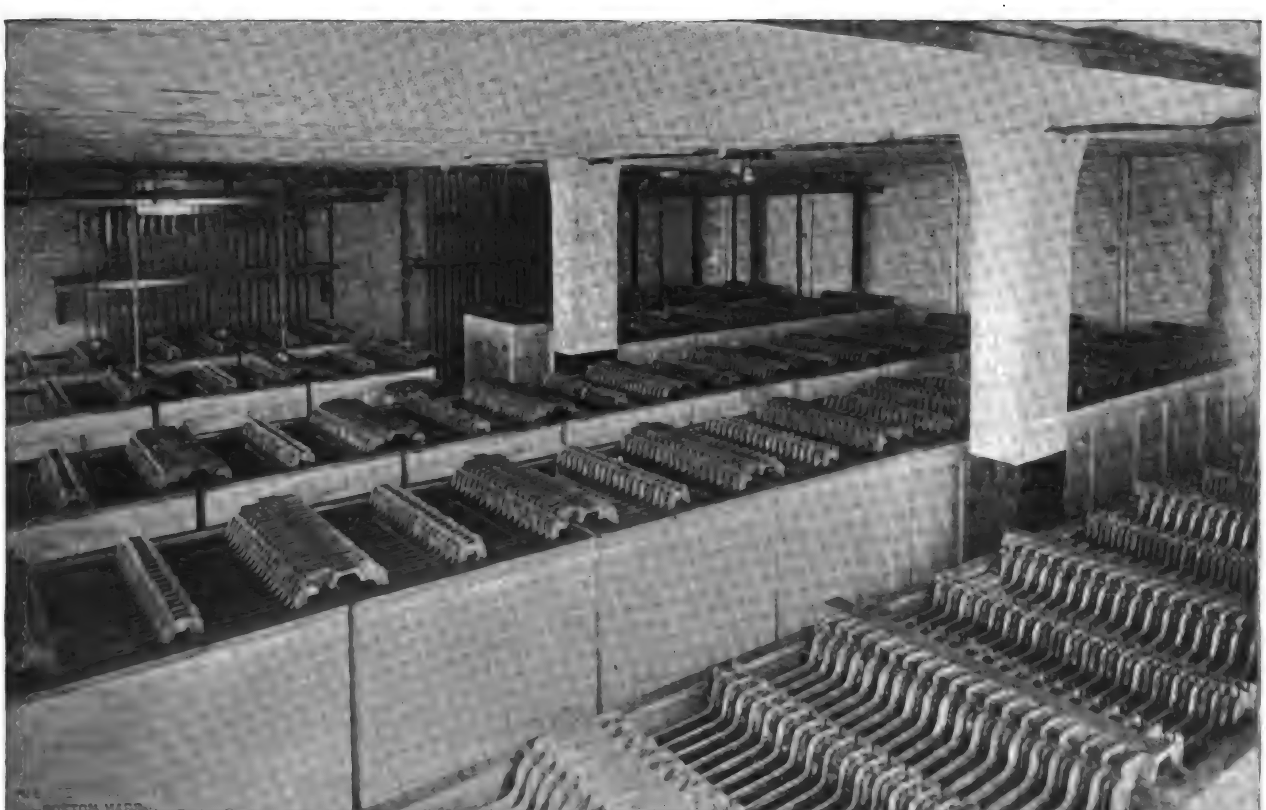


FIG. 1.—STORAGE BATTERY ROOM, HEAD PLACE STATION, EDISON ELECTRIC ILLUMINATING CO., BOSTON, MASS.

THE BATTERY.

The entire third, fourth and fifth floors of the new building are occupied with the battery which is composed

of 144 cells of the well known Tudor type, arranged in rows, as shown in the accompanying engraving, Fig. 1, and suitably connected with the rest of the lighting system as will be described later. Each cell is composed of a stout wooden box, lead lined, 3 ft. 10 in. long, 3 ft. 4 in. wide and 3 ft. deep. In this box are suspended the plates, each cell having 18 positive and 19 negative frames standing on edge. Each positive frame is composed of 16 plates 7 inches square; while each negative frame has four plates 14 inches square. These plates are all secured in their respective frames by lead strips soldered.

The floor space of the battery rooms is about 40 ft. by 36 ft., the cells being arranged in six rows as shown. The connections between the cells and switchboard are flat copper bars ½ inch thick and from 3 to 6 inches broad, according to requirements. Noting particularly one side of the entire system, all the 42 cells can be connected in series, while in addition a certain number have direct connection with the switchboard, so that by the automatic regulation, any number of cells, from 42 to 72, can be used in series for discharging. There are thus, 30 copper bars in each side of the system, 60 in all, and two neutral bars, which lead from the battery room to the switchboard. These bars are all supported overhead by iron hangers with fibre insulators.

In erecting this building for such a purpose, particular care was taken to secure good insulation. To this end the floor is made throughout of slate. On the floor are placed slabs of slate; on these are placed round porcelain insulators, and on these the cells stand. The voltage of each cell on discharge is 1.75 at the lowest, but averages about 1.85. On charge the voltage varies from 2.1 to 2.5.

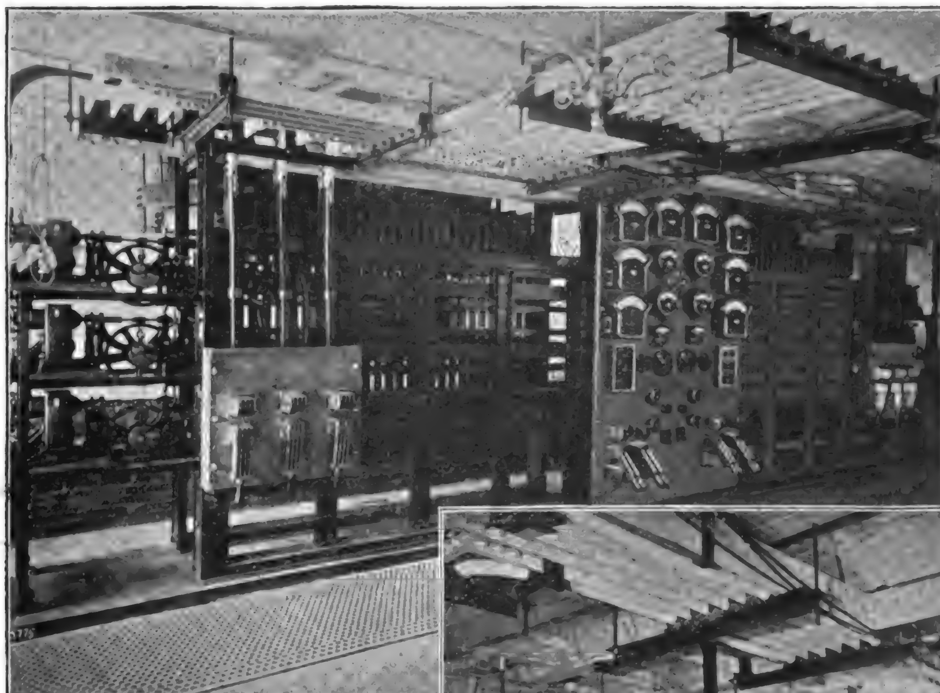


Fig. 2.—The Storage Battery Switchboard.

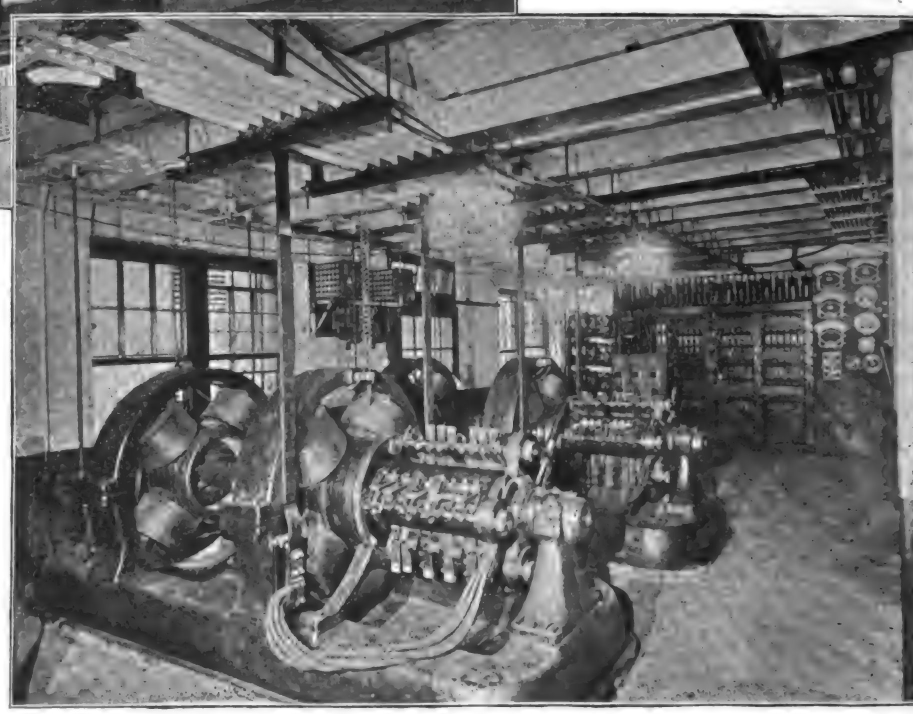


Fig. 3.—Boosters used in Connection with Storage Batteries.

The chief supports of these frames in the cells are thick plates of glass standing on edge, on the upper side of which the bearings for the frames rest. These glass supports, of course, extend to and rest on the floor of the cell, while the frames in which the plates are fixed do not reach the bottom by about six inches. The plates are held in position about ½ inch apart by glass tubes arranged vertically, which, besides maintaining the plates at equi-distant spaces, also secure good insulation.

The plates themselves are of a peculiar type special to this system, their surfaces being formed in grooves with intersecting indentations running at right angles to the grooves. By these means the active material is easy of application to the surface of the plates. When it is necessary to remove the plates for any purpose, which thus far has been very seldom, little or no difficulty is experienced, as they are simply held in position and steadied by means of lead springs which act between the sides of the cells and the edges of the frames in which the plates are fixed. About 640 litres of dilute sulphuric acid is required for each cell. All water used with the acid is distilled on the premises, being the exhaust steam condensed and distilled for the purpose.

THE SWITCHBOARD.

The switchboard which was designed by Mr. C. S. Van Nuis and built by Messrs. A. & J. M. Anderson, of Boston, is of blue slate, 8 ft. high and 5 ft. 6 in. wide On it have been installed 8 Weston central station ammeters of the standard type; 2 round pattern Weston ammeters; 2 Weston voltmeters which are used for testing the voltage of each individual cell; and 6 starting switches in crystal faced cases, the object of which is to start the regulating electric motors described below, and by means of which the current is cut out or in from any individual

or series of cells in the battery. As will be seen from the accompanying engraving, Fig. 2, the switchboard is placed in front of a massive structure specially designed for this installation. It consists of a series of flat copper bars fixed horizontally in a framework of iron, and connected with the battery in the room above by means of copper bars, 3 inches and 6 inches wide by ½ in. thick.

It is, of course, already understood that the function of the battery plant is auxiliary to the main supply, so that, according as the demand on the main circuits is much or little, the arrangements are so thorough and complete that the battery current is availed of to equalize the system, thus ensuring a more equal load on the engines and dynamos at all times than would otherwise be possible. To accomplish this, then, a sliding contact on the main copper bars was designed, and the value of the automatic working of the six motors alluded to above comes in.

Thus, when there is an abnormal demand on the main circuits the motors are started according to requirement, and immediately throw into circuit as many cells as may be requisite to meet the demand. Instantly, on the demand being met, the motors are stopped automatically or reversed, and the cells maintained in circuit for the necessary time, or cut out as the demand decreases. The motors used for operating these sliding brushes are of ¼ H. P. capacity each and are arranged one above the other in groups of three at each end of the lines.

It should further be stated that on this switchboard there are, in addition to the instruments enumerated above, two sets of main battery switches, single throw, with four blades each, and capable of carrying 3,500 amperes each. There are also four double throw booster switches for use in connection with the two boosters recently installed, having a capacity of 1,500 amperes and 50 volts at 750 revolutions per minute. These boosters, shown in Fig. 3, are driven by direct connection with motors, their function being to increase the voltage at the bus bars of the auxiliary busses.

By the side of the main switchboard is a large slate indicating board on which are installed 4 Weston voltmeters, 2 ammeters, 4 circular Wirt voltmeters, all for testing the pressure on the various bus bars, and on the ends of the feeders. The aggregate maximum capacity of the two battery plants the company now owns, should it ever be necessary to draw on it for a very short time, is about 30,000 amperes, equal to 60,000 lamps of 16 C. P. each. It is unlikely, however, that the batteries will ever be called upon for such an output. For, say, one and a quarter hours, the Head Place battery would furnish 6,600 amperes at 110 volts which would be equivalent to about 13,000 lamps.

THE MERITS OF THE SYSTEM.

In operating these storage battery plants it has been found that there are several advantages derivable therefrom. Primarily, they were installed to help out the maximum load, and it has been found that the batteries come cheaper than steam plants of the same capacity. The reason for this is that they are ready for use at all times, and therefore are available during one or two hours during which the maximum load exists, thereby avoiding the necessity for running the steam plant too hard at any time.

Then they are most useful for carrying the entire load of the system nights and Sundays, thus saving in labor when the output is small.

A third advantage is that of evening up the load on the engines and dynamos. This latter use is found to be the most important of all in operating the system. The batteries are always in circuit, either taking in or giving out current at all times. It is thus possible to run engines with a load that never becomes less than three-fourths of their capacity, thus securing a saving which more than counterbalances the loss of energy in the battery.

The records kept by the Edison Electric Illuminating Co. show conclusively that notwithstanding the fact that the batteries have only 75 per cent. efficiency, the actual cost of the coal used is less than it would have been if the batteries had not been installed. The company has thus been enabled to instal the batteries to take care of the maximum load, at a less cost than a steam plant; and at the same time get all the other advantages given by them.

More than once the Edison stations have been completely shut down for fifteen hours or more; yet the batteries have satisfactorily furnished current for their whole extensive systems; hence the directors are more than satisfied with their auxiliary installations.

In closing we may add, that so great is the confidence of the makers in the quality and efficiency of their batteries that they undertake in furnishing them to insure and keep them in repair at 4 per cent. per annum of the original cost.

THE OHM STATUE AT MUNICH.

On July 5th, during the third annual meeting of the Verband Deutscher Elektrotechniker at Munich, a statue of Ohm was unveiled in presence of a large number of members of the Verband. The statue is of white marble, and stands in the square in front of the Technical High School. Around the pedestal there are figures in relief. There is also an inscription to the effect that the statue has been "erected by his admirers and disciples." Funds were raised by subscription, the first appeal for which was made six years ago, on the occasion of the 100th anniversary of Ohm's birthday, to which England, France and America liberally responded. In all $10,000 was subscribed. The statue was designed and cut by Profs. von Thiersch and von Ruemann after an old photograph and a painting of Ohm in the possession of the Academy of Science, and from description furnished by still living friends. Ohm was born at Erlangen on March 16, 1789. He was the son of a master locksmith, who was able to teach his son mathematics. Ohm's first post was that of teacher of mathematics and physics in Gottstadt and Neuenburg in Switzerland. Thence he returned to his native town and acted as *privatdocent* at the university there for a short time. From there he went to Bamberg, and later to Cologne, where he published his chief work, "The Galvanic Circuit Mathematically Elaborated." Later on he became a professor at, and ultimately rector of, the Polytechnic at Nuremberg. He was 60 years of age when he went as professor to Munich, where he worked until his death on July 6, 1854.

AN ELECTROMAGNETIC MERCURY EFFECT.

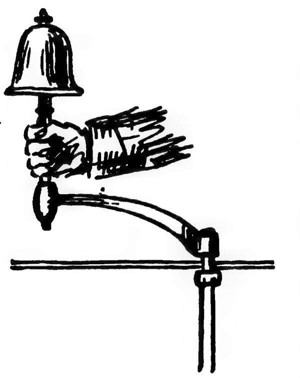
In a paper read before the London Physical Society, Mr. Bowden describes the following curious experiment. A long glass tube containing mercury and fitted with a small standpipe to indicate the hydrostatic pressure, is passed between the poles of an electro-magnet. On passing a current of about 30 amperes through the mercury in this tube, the standpipe being turned so as to indicate the pressure either perpendicular or parallel to the lines of force of the field of the electro-magnet, movements of the mercury in the standpipe take place. When the standpipe is perpendicular to the lines of force of the field, the

mercury rises or falls according to the direction of the current. When the standpipe, however, is parallel to the lines of force, the mercury always rises, whatever the direction of the current.

ROUNDABOUT NOTES IN ELECTRICAL EUROPE.—IV.

BY

DRESDEN.



Brake Handle and Bell.

In this interesting city in addition to the numerous street-cars with and without decks, and a small regiment of cabs, there are two electric lines. The more important of these leads to Blasewitz and competes with the swift boats plying on the Elbe, for the local traffic. The Blasewitz line is modern and starts from the magnificent Belvedere in the heart of the city, between the old and new "stadt." There are 16 motor cars and 18 trailers employed. The cars are in every sense up to date and present an attractive appearance, largely due to the fine dark colors in which they are painted. While some of the trucks are of German manufacture, the management has its eye upon American practice and it secured some time ago a truck from America which they have imitated closely by having counterparts made. The line is owned by the Deutsche Strassenbahn Gesellschaft. Here, as in other places, the management have no hesitation in stating that they do not undertake to notice any letters written in English; therefore, any progressive American manufacturers who desire to push business in Dresden will be obliged to correspond altogether in German.

As the line starts near the Hoffkirche, Opera House and the famous Dresden Galleries, it is in good position to cater to the riding public. Very fair speed is made and the cars run comparatively noiselessly. The peculiar bell which is used for warning pedestrians and others is shown in the offhand sketch herewith. It will be seen that the motorman has the brake and bell in his hand, so that while braking he can sound the alarm by simply raising and lowering the tube on the brake-handle. The Company's power-house is located between Dresden and Blasewitz, and is substantially constructed of brick and iron. The offices are in the city proper. The line is doing a good business, and within a very short time will put on 30 additional motor-cars. Director Stoesner manages the affairs of the Company and is assisted by Engineer Hubrech. As this city possesses very many attractions, it is obvious that there will be a bright future here for electric traction, especially as the people are greatly pleased with the results thus far obtained.

The other road referred to is destined to become very important, and has contracted for 45 motor-cars with the well known Union Elektricitäts Gesellschaft as a beginning.

VIENNA.

This well-known city lying along the Danube and Wien, is world-famous. Its magnificent avenues, streets, municipal building and palaces all show the march of improvement, but singular to state, electric traction has made no headway here. There are no electric cars running in the city proper and the nearest approach to electricity is the short line (about four miles) from the outskirts to Moedling, employing less than 10 motor cars and a few trailers. The public is served by numerous omnibuses, cabs, and antiquated horse-cars. The speed of these horse-cars is painful to witness and anyone requiring to reach his destination speedily, would do better to walk. Time, however, does not seem to be of very great importance and the people remain apparently content. Their leading objections to the employment of electric cars are, first, the fear that the cars will spoil the city streets and secondly, that the running of electric cars will interfere with the very many private equipages which the Viennese own. Of this there seems to be a decided fear.

Electric lighting is carried on to a great extent and the stores, hotels and public buildings are beautifully illuminated. In the Grand Opera House electricity is employed to advantage for spectacular effects and I have never seen a more beautiful display of stage lighting than was given there. It is to be hoped that ere long many motor cars will be running. A well-managed line should reap a rich harvest, especially as cab hire is very expensive.

NUREMBERG.

This city has been familiar to us all from infancy, chiefly because of its being the toy centre of Europe. To the electrical mind, however, it is important as being the head quarters of the Elektricitäts Actien-Gesellschaft, vormals Schuckert & Company. This is one of the great electrical manufacturing concerns of Europe. The technical director is Henry Bissenger. He keeps himself well informed on electrical matters in America, and The Electrical Engineer is at his hand for constant reference. A register of visitors is kept in the reception room, and on glancing over it I noticed the names of a number of American electricians and manufacturers to whom the usual courtesies were shown. The Company pays particular attention to the lighting business, but of late has been reaching out into the street railway field. Nuremberg has so many narrow streets, steep grades and serpentine windings that it is not a good place for the operation of an electric line. In fact, in some parts, a funicular road (such as exists at Ouchy near Lausanne, Switzerland) would be more profitable. While however, electric traction may not be seen here, the E. A. G. is represented by different roads which it has equipped in other parts of Europe. A particularly fine lighting display was made by the Company on the Koenigs Insel (King's Island) in the river Alster, Hamburg. This island was built at considerable expense in order that the Kaiser might have a place in which to enjoy his coffee and cigar while on his way to open the North Sea Canal. The island was covered with hundreds of arc and incandescent lamps and presented a most beautiful appearance when the illumination was at its height. Great credit is due to this enterprising firm for the way in which the installation was made. After a few days, all the lamps were taken down and the island (which had been built on piles in the river covered with dirt and plaster) was destroyed. While the display lasted it was a grand advertisement for the Nuremberg concern. They are rehabilitating a short tramway line in Hamburg but thus far have done no tramway work in Nuremberg.

THERMO-CHEMICAL CARBON BATTERY.

M. Korda, in *Compt. Rend.*, states that experiments made with a view to ascertain whether in the reduction of metallic oxides there is a development of electrical energy, show that only in two of the cases investigated is there any distinct E. M. F. Barium peroxide in contact with carbon heated at dull redness gives an E. M. F. of about one volt. Other peroxides, such as those of manganese and lead, show no similar behavior, probably because the product of reduction is a conductor and forms short-circuits with the carbon. Copper peroxide and carbon, when separated by fused potassium carbonate, give an E. M. F.

of 0.9 to 1.1 volt. If the potassium carbonate contains water, the current is at first in the opposite direction, but changes as the temperature rises. In both cases the E. M. F. is considerably lower than that calculated from the known thermal disturbances, and it follows that only part of the energy is liberated as electrical energy. Faraday's law is not applicable, because of the continuous supply of extraneous energy in the form of heat.

INSULATED WIRES AND THEIR PECULIARITIES.

BY

A. E. Dobbie

CERTAIN friends having criticised my article on Interior Work, in THE ELECTRICAL ENGINEER of Aug. 7, in which I expressed a preference for weatherproof wire in dry places, led me to investigate the subject more closely. The objection to rubber insulation does not come so much from the price—for rubber insulation is now very nearly as cheap as weatherproof—as from the fact that when exposed to the air, or in dry, hot places, it has not the durability or lasting qualities of the braided asphaltum kinds; and it seems to make very little difference as to the grade of rubber one purchases, a well-known brand which has a factory guarantee of 1,000 megohms to the mile and which is made of the highest grade of gum not having as good lasting qualities as another and much cheaper wire which is a soapstone and chalk compound and has only gum enough in its composition to hold it together. Again most rubber compounds contain more or less sulphur and in case the insulation becomes broken at cleats or tie wires a slow but steady corrosion takes place which is not the case with asphaltum covered wires.

Suppose the wire does not have an insulation of 1,000,000 ohms when placed in water for two weeks. Would not a wire which has an insulation of, say, 500,000 ohms and maintains it for five years be better than a wire that starts with a factory test of 500 megohms and falls to 100,000 ohms in two years and 1,000 ohms in five years?

So well is this known among experienced electrical engineers that in certain parts of the country they will not use rubber covered wire unless compelled to. Throughout the South and in many of the western states this insulation is almost tabooed, the dry air of the Rocky Mountain region being especially trying, while on the Pacific Coast where it rains from six to nine months in the year nothing else is used. Asphaltum will not resist long continued dampness, while it seems to preserve rubber As long as rubber can be kept away from the air, it makes the best insulation for wires that we have. In mouldings it lasts much longer than in cleat or concealed work; some wires that have been in moulding to my knowledge for seven years are still in good condition due to the fact that the temperature is much more uniform and that the air cannot circulate freely around them. Wires in conduit would probably last a long time for the same reason.

I have some samples in my possession collected from various sources and here is what I find ·

Sample No. 1: Duplex wire, rubber insulation, that has been buried in plaster of paris for about four years as nearly as I can learn; a well known brand with a good reputation. The insulation is very tender; a slight pull will rip it off. If a water pipe should break and wet the walls I think there would be several short circuits in that building. Some single wires with a heavier insulation, run the same way, showed up considerably better and would last two or three years longer. Some others that lay on top of picture moulding exposed to surrounding air, were in about the same condition. Short circuits, however, are not so much to be feared as electrolysis.

Sample No. 2: Underwriters' wire, double braided, in wooden moulding with plenty of air space around it. Condition as good as ever; no signs of decay or electrolysis, but as it has been used now for seven years the insurance inspectors will probably soon order a change. Some rubber insulation placed in snug fitting moulding at the same time, is in good condition still, because placed in a cool cellar; while the same wire strung on cleats in the attic will soon have to be replaced. The wires were considered the best on the market at that time and their manufacturers still hold their own.

Sample No. 3: Taken from the roof of a building down town. Insulation, double braid, asphaltum compound. Time, five or six years. Outside braid shows effects of the weather but the inside seems to be as sticky, tough and gummy as ever. Rubber insulation in the same locality is peeling off.

But on the Brooklyn Bridge I found a fine lot of specimens that had been exposed to the weather about twelve years, and represented several different kinds and conditions of wear. Some underwriters' wire that has been given several coats of paint is still doing duty, and doing it as well as ever.

But nearly all the the wire used for arc lighting has a core of rubber which answers to all the tests of pure gum. One kind appeared to be a pure para unvulcanized cement, surmounted by two braids. The core kept from the air is as good as ever the only exceptions being that where the tie wires have broken the insulation, electroylsis has set in.

Another kind in use is a black gum of the best rubber, partially vulcanized, outside of which is a layer of tape and two braids. The gum is hard and somewhat brittle now, but is still firm and in good condition. Mr. Cunningham, the Bridge electrician, tells me that the insulation is practically as high now as it ever was. Both of these wires appear to have been thoroughly soaked with asbestos paint on the outside. In addition they are painted with a heavy oil paint every time the iron work on the bridge is painted, which is about every two years. The paint excluding the air, has preserved the insulation for twelve years, and it appears good for five years more.

The Bridge telephone wires are not all painted and the difference is quite marked. The rubber insulation is cracked and brittle, and ready to fall off. The paraffine braided insulation is hanging in shreds. Some asphaltum braided wires are fairly well preserved; and a rubber insulation with an outside braid soaked in asphaltum is in very good condition; this last, has only been in place about four or five years. Some of the joints that were covered with common friction tape, show the effects of oxidation or electrolysis.

Conclusion: To my mind an insulation composed of a light rubber core with two asphaltum soaked braids, or a tape and braid on the outside, would make an ideal insulation for ordinary housewiring. If you have to use a rubber core single braid wire, select one soaked in compound instead of shellac. Never take a wire with tape winding on the outside; tape is liable to unwind in handling the wire and loosen up the rubber. Tape wound wires never last except in moulding. Braided wire comes at the same price. It is advisable to select a wire—if of rubber—in which the core is made up of two layers; then if one crumbles or cracks, the other still affords some protection. For cleat work or concealed work in dry places, use weather-proof wire, if the inspectors will let you; the same applies to conduit, double tube work.

If I were an inspector I would pass anything that was placed in conduits, even the despised Underwriters' wire, unless in damp places, and I would pass it there, if in iron armored conduit. The only danger to be feared from this wire is electrolysis: I never knew it to make a short circuit. Some of it on open cleat work has been up for nine years in New York city and is still good. On porcelain

knobs or cleats, I can see no objection to it, except in damp places. I do not, however, wish to advocate Underwriters' wire for general housewiring.

COPPER-SHEATHED HARBOR CABLES.

BY IRA W. HENRY,

Electrician Bishop Gutta Percha Co.

The New York Harbor Electric Buoy Cable was not armored with a copper sheathing without the previous collection of a large amount of data upon the action of salt water on copper, irrespective of the greater electric problem of self-induction that demanded the use of a non-magnetic metal.

Copper and its alloys have been used many years, as the London *Electrical Review* states, for the sheathing of vessels; but with results that still merit its continuance. Among many examples, is the Brenton Reef light ship, that was sheathed with copper plates one thirty-second of an inch in thickness, over twelve years ago, and when it became necessary to re-calk her, it was found that the plates showed no signs of deterioration, being practically as good as new. As to iron or mild steel armor, samples have been examined after eight years' service that were eaten to needle points in many places, making the most dangerous condition imaginable for submarine cables.

As the indestructibility of gutta percha for submarine insulation is well known, it was thought that with copper armor the life of the cable would be indefinitely prolonged.

THERAPEUTICS OF HIGH-FREQUENCY CURRENTS.

The paper read by Dr. Apostoli on this subject at the meeting of the British Medical Association is an important one, the *Lancet* says, and represents the direct practical application of the physiological facts brought about by D'Arsonval's experiments with animals. The current of high frequency and high potential is caused to traverse a large helix inside which the patient is placed, and the effect is to set up induction currents of a similar kind inside the patient's body. These travel in closed circuits through the tissues and produce nutritive changes, which can be recognized by their effect in increasing the elimination of carbon dioxide and of urea. The actual figures are promised at an early date. The results are good in diseases characterized by failure or impairment of nutrition, and accordingly Dr. Apostoli reports successes in anæmia and debility, gout, rheumatism, neurasthenia, and hysteria. In diabetes, also, there have been some favorable cases. The principle of the localized application of electricity for the relief of disease, so ably insisted upon by Duchenne, has delayed the recognition of the important general effects to be obtained from electrical treatment. At present there is a distinct movement in favor of general electrification as a therapeutic means, and the results appear to be almost identical in character, whether the method employed be by the alternate-current electric bath, advocated by Gautier and Laret, or the high-potential induction method of D'Arsonval and Apostoli, or the electrostatic methods favored by Vigouroux and Morton, of New York, who use the Wimshurst or some similar machine as the source of the electricity applied.

ELECTRIC TRANSPORTATION DEPARTMENT.

ACCUMULATOR TRACTION.

BY MAURICE BARNETT.

Now that storage battery cars are to be introduced in New York on the Fourth Avenue Railway, on the understanding that if storage battery traction prove more practicable and economical than other representative traction systems, the cars on the Fourth and Second Avenue lines will be equipped with storage batteries, it is a matter of considerable interest to railway and electrical men to know how far the hopes of friends of the storage battery are liable to be realized, and what showing battery traction will make against its competitors, (1) the trolley system, and (2) the underground conduit system. In this connection it might be said that although the underground-conduit system has obtained a foothold here sooner than the storage battery system, it is very doubtful whether the former will ever come into general adoption. The closest estimates on total investment, including real estate, road and complete equipment,—estimates based on a study of the systems in New York and Washington,—put the cost of the underground system at about $100,000 per mile of track length, or between three and four times that of the storage battery system. Moreover, the total operating expenses of the underground system including interest on investment is about 19 cents per car mile against 15 cents for the trolley. This large difference is accounted for by the excessive interest charge which the former system must pay. The necessity for some system other than animal traction and trolley traction has, of course, led to the adoption of the underground conduit, but it is almost certain that just as soon as it shall have been demonstrated that storage battery cars can compete, under certain conditions, successfully with the trolley system, underground conduit systems will play an insignificant part in the development of electric traction systems in the United States.

The Electric Storage Battery Company, of Philadelphia, which is putting in the new cars in New York appears to be more than sanguine as to the results which will be obtained with the new cars which, in many respects, embody radical points of departure from previous types of storage battery cars. The Storage Battery Company are basing their estimates as to capability of their cells upon actual knowlege of the work that is daily being done with the Chloride accumulator in storage battery traction in France where a type of battery similar to that to be employed in New York, has given satisfactory results.

There has never been any doubt as to the advantages possessed by a storage battery system of electric traction; the only doubt ever expressed being one concerned solely with the question of operating expenses. The great drawback has been, not, as many persons think, the weight of the battery, but the cost involved in the maintenance and handling of the cells in traction work. In the old style storage battery cars, the battery was placed in the sides of the cars under the seats. The expense of inserting and removing this, each trip, added considerably to the operating expenses. In the new cars the battery will be placed under the car where it can be handled easily and at about one-quarter the former cost of this operation. A report by M. J. Sarcia, which can be found in the *Bulletin de la Société Internationale des Electriciens* leads to the hope that the cost of maintaining and handling batteries in traction service will be, in the style of car suggested, something under three cents per car mile. We hope below to be able to show that this amount can be made up by a saving in interest, a diminished expense for maintaining motor equipment and a smaller cost for the motive power.

The favorable features of a storage battery system of traction are well known and have reference to the fact that each car is a unit by itself, independent of the power house during its trips, and in no way embarrassed by derangement in the station or overhead equipment—differing in this respect from the trolley system where a stoppage in the power house or trouble on any section of the circuit may hold up all the cars on the line or in the section, as the case may be, until the trouble is removed. Again, as the load on the engines and dynamos in a storage battery system is constant it follows that these need not have greater capacity than is sufficient to satisfy the average demand for power. In the trolley system the capacity of the power plant must be such as to enable it to respond to the maximum demand made upon it. As this demand is very variable, being anywhere from 20 to 300 per cent. above the average demand, it follows that the power plant for a storage battery system will be considerably smaller than that required for the trolley system. Mr. O. T. Crosby puts the relative capacity required by the trolley and battery system power plant, respectively as 1 : $\frac{2}{3}$. In other words the battery system will require a power plant only two thirds as large as that required by the direct system. In considering, later on, the relative cost of construction under the two systems, this ratio will be taken. (This, incidentally, emphasizes the value of an auxiliary storage battery plant for roads already equipped with the trolley system, the storage battery serving as a reservoir to store up the energy representing the difference between the average and the

maximum demand on a generating plant; and as a regulator, enabling the engines and dynamos to be worked at a constant load and securing them from the strains and stresses to which they would otherwise be subjected).

Furthermore, in the storage battery system there is no loss of pressure in "feeders" and "line"; the grounding of one motor does not affect others; the durability of the motors is greatly increased by reason of the low pressure used in this system, and lastly, there is not the unsightly trolley line.

In order to arrive at an approximate cost of traction by storage battery cars we may consider separately the various factors entering into this. What chiefly interests us is the factor of maintenance and handling. This, according to the report of M. J. Sarcia already referred to, was 3¼ cents per car mile—a figure, however, susceptible of marked reduction. In order to explain this and at the same time to show that the basis of above figure was a set of conditions not wholly favorable to storage battery traction, it may be interesting to give in brief, a synopsis of M. Sarcia's report, descriptive of the industrial application of Accumulators to electric traction made by the Tramway of Paris and the Department of the Seine on the lines of St. Denis to Paris and of St. Denis to Neuilly.

The lines in question which are known as (1) Saint Denis-Madeleine, (2) Saint Denis-Opera, (3) Saint Denis-Neuilly, have their termini near the depot of Saint Denis. On these lines electric traction superseded horse traction June 1, 1892; and, up to the present time about 2,000,000 car miles have been covered by the storage battery cars. On these lines the grades are fairly severe, being as high as 4 per cent. for considerable distances and ranging frequently from 2 to 2½ per cent. On the Madeleine line each car covers daily from 88.8 to 97.5 miles. With horse cars the distance covered daily was not over 60 miles. The conditions on the Opera line differ in so much as the motor car tows an ordinary car holding 50 persons—making 100 persons carried in all on this line by each motor car. On the Neuilly line each one makes two trips out and back on the Opera and Madeleine lines—or about 80 miles on a single charge of the battery. On good Vignole rails where the traction coefficient was only 18.2 pounds to the ton, the distance covered on each charge of battery was no less than seventy miles.

Continuing, M. Sarcia points out that in order to replace a discharged by a fresh battery it was necessary to handle 24 trucks —the men having, frequently, to roll these the entire length of the charging room—involving a very large expenditure of labor. The necessity for this grew out of the circumstance that the Company, instead of building a modern power house with every convenience for reducing the handling of the batteries, rehabilitated the old horse car stable and converted it into a charging room. Obviously economy in handling could not be expected under such conditions. Moreover, instead of supporting the battery under the car, it was placed in the sides of cars underneath the seats. Sarcia estimates that in the style of car to be used in New York a saving of .6 cent per car mile could be effected in handling. Subtracting this from 3¼ cents given as a result actually obtained in practice, we have 2.7 cents as cost per car mile for maintenance and handling of battery.

Regarding cost of power, this will depend on price of coal at power house, cost of labor, oil, waste, water and other supplies—illustrating the difficulties encountered in making a comparative estimate of costs of power in different systems. From a paper by T. S. Badger on the cost of construction and operation of electric railways, we find that the average cost of power per car mile of 22 trolley roads with from 3 to 140 cars in operation, length of track 2 to 51 miles, daily mileage 80 to 150, average daily mileage 110,—was 1.96 cent. Now, as in the storage battery system, engine and dynamos are run at a constant load, it is safe to assume that cost of power, neglecting interest and depreciation will not exceed 80 per cent. of the figure given, or 1.56 cent per car mile. Authorities are not wanting who ascribe to the storage battery system an even greater efficiency. In Dubuque, Iowa, with a comparatively small number of storage battery cars in operation, the cost for power was only 1.80 cent per car mile—bearing out the belief that 1.56 cent is quite within the limit for well designed power houses operating a fair number of storage battery cars.

As already stated, owing to the low pressure used in the storage battery system, the durability of the motors is very greatly increased. The average maintenance cost of the rolling stock of the 22 trolley roads cited, is 1.80 cent per car mile. M. Sarcia puts this factor at 1 cent per car mile. In New York where every effort will be made to introduce the very best electric equipment and carry on the work under the most favorable conditions, it is safe to say that the true figure for maintenance of rolling stock will not be more than .8 cent per car mile.

Regarding maintenance of power plant, it may be said that inasmuch as the power plant in a storage battery system need be only two-thirds as large as that in a trolley system, the maintenance cost will be only two-thirds as large. As a matter of fact it will probably be only one third as much, since the machinery is free from the strains to which it is subject in the direct supply system. There being, furthermore, no external circuits, lightning is less apt to play havoc with the electrical part of the equipment.

Coming now to the question of interest on total investment, consider first the investment per mile of track length of the trolley system. Trolley construction, where iron poles are used and where, as in cities, the feed wires must be buried, will cost about $12,000 per mile of single track. As 16 to 20 foot cars can be had fully equipped for say $3,250 each, two cars (to the mile) will cost $6,500. Making an allowance of 15 H. P. per car at $100 per H. P. for power plant, but not including real estate or buildings, we have for the two cars $3,000. Cost of road bed will add about $7,500 per mile of track, while real estate, buildings, etc., may be assumed to be $7,000 per mile of track—making a total investment of $36,000 per track mile. On the basis of 56,000 car miles run per annum per mile of track length, we have at six per cent. per annum an interest charge of 3.85 cents per car mile run to be added to operating expenses. For storage battery construction there is an item approximating $7,600 for batteries for the two cars not found in trolley construction. On the other hand, a saving is effected of $12,000 for overhead construction, while the cost for power equipment and real estate is reduced by one third, being $2,000 for the former and $4,666 for the real, estate, buildings, etc. We thus have a total cost of construction of $28,267 or, say $28,000; and with the same trackage as in the case already considered, we have an interest charge, per car mile, of 2.99 cents.

Assuming that in the two cases just considered, maintenance of roadbed and track, transportation and general expenses will remain the same, we can arrange in parallel the values already given. A general distribution of expenses per car mile is then as follows:

EXPENSES PER CAR MILE.

	Trolley.	Storage Battery.
Maintenance of roadbed and track	.54	.54
Maintenance of line	.18	......
Maintenance of power plant	.36	.12
Maintenance of rolling stock	1.80	.80
Maintenance and handling of batteries	......	2 70
Cost of power	1.96	1.56
Transportation expenses	4.98	4.98
General expenses	1.26	1.26
Interest on total investment	3.85	2.99
Total	14.98	14.95

As given here, the cost of operating cars by the trolley and storage battery systems, respectively, on roads of fifteen miles and upwards, with twenty or more cars averaging about a hundred miles daily, with moderate grades—general conditions covering cost of fuel and supplies, wages, etc., being uniform,—shows both systems to be on an equal footing. A set of conditions slightly in favor of storage battery construction, would show greater economy for the battery system. Thus if the length of track was large in proportion to number of cars run, the extra interest on greater relative cost of trolley construction, would swell the operating expenses of the trolley system. Or again, since item of fuel is the largest factor in "cost of power," localities where fuel is high priced, would change the totals and make battery traction more economical.

In conclusion, it may be said that even if trolley traction were more economical than storage battery traction, the system would be open to the objections that the (1) cars are dependent at all times on the power house, and have no auto-mobile character as have battery cars; (2) the moment the trolley leaves the line the cars are left in darkness; (3) the high tension currents constitute a source of danger to the travelling public; (4) the trolley line is unsightly; and (5) overhead wires are a formidable obstruction to firemen engaged in the never pleasant work of fighting fires. Inasmuch as a successful storage battery system would be, both from the point of view of the public and the street car company, what Mr. F. L. Pope calls "an ideal solution of the problem of electrical transportation," it is evident that this system—having total first cost and operating expenses in its favor—is bound to have a speedy and wide development and play no insignificant part in the future history of electric traction in this and other countries.

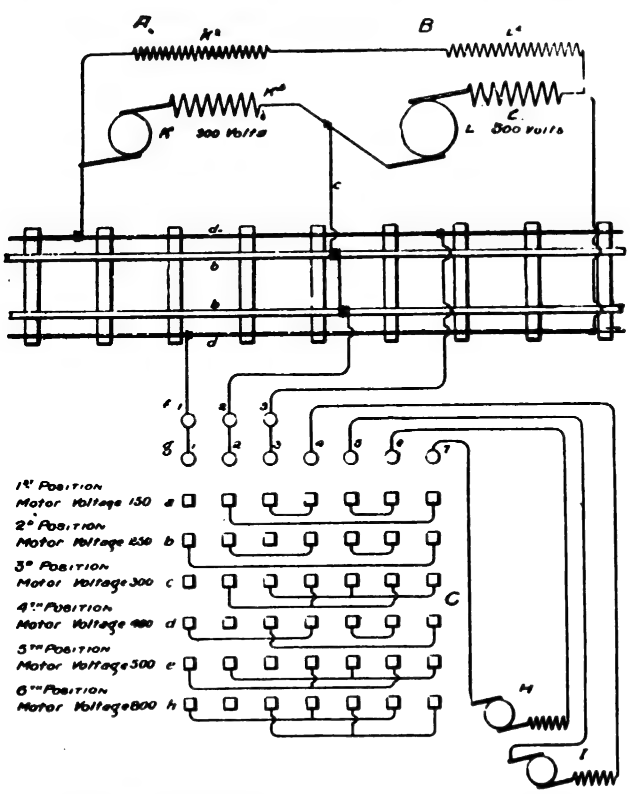
TO REGULATE THE BLOCKADING COAL CART.

An ordinance has been introduced in Philadelphia by Councilman Harris to prevent the obstruction of street car lines by coal carts. While the unloading of coal for house use is recognized as a necessity, say the local papers, there is no reason why the owners of carts in performing this labor should be permitted longer to inconvenience and annoy the public. Passengers in street cars have a right to expect that they shall not be detained for an indefinite period while some coal heaver leisurely pursues his task, nor ought pedestrians be compelled to scramble over a pile of coal on the sidewalk, or take the alternative of passing around by way of the road. The only wonder is that some measure like that of Councilman Harris was not proposed and adopted long before this.

HENRY'S THREE-WIRE RAILWAY SYSTEM AND METHOD OF MOTOR REGULATION.

In the operation of electric cars the common method now employed is what is known as the series-multiple arrangement. In it numerous changes are made in the motor circuits to gradually increase or decrease the speed. The common practice is to have but two running positions—that is, when the motors are in series or when they are in parallel with each other. The other four or five changes are usually made by adding resistance to the motor circuits which absorb a certain amount of energy. To overcome this waste, Mr. John C. Henry, of Colorado Springs, has devised a method of distribution combined with an arrangement whereby all desirable changes are made without the use of resistances.

The system is illustrated in the accompanying diagram in which A represents a compound-wound dynamo arranged to give a potential of three hundred volts; B, a similar dynamo of larger capacity arranged to give a potential of five hundred volts. These machines are connected in a novel manner to the well-known three-wire system. *bb* represent the track-rails of an electric railway to which the neutral wire *c* is connected. *d* represents one of the mains from the dynamo B. *d'* represents the other main leading from the dynamo A. At H is shown motor No. 1 with its wires leading to the switch terminals at 6 and 7, line *g*. I represents motor No. 2, whose wires terminate at 4 and 5 on the same line.



HENRY'S THREE-WIRE RAILWAY REGULATION SYSTEM.

C represents a switch the contact points of which are made to move upward and engage with the terminals on the line *g*. In the first position the contacts 2, 3, 4, 5, 6 and 7 line *a* engage with the similarly numbered terminals on line *g*. In this position the two motors are in series and receive current from the dynamo A. They are each then working under a pressure of 150 volts. In the second position contacts 1, 2, 4, 5, 6, and 7, line *b*, engage with the similarly-numbered terminals on line *g*. In this position the motors are in series and receive current from dynamo B. They are each consequently working under 250 volts pressure. In the third position contacts 2, 3, 4, 5, 6, and 7 engage with the similarly-numbered terminals on line *g*. In this position the motors are working in parallel and receive current from the dynamo A under 300 volts pressure. In the fourth position the contact-points 1, 3, 4, 5, 6, and 7, line *d*, engage with the correspondingly-numbered terminals on the line *g*. In this position the motors receive current in series from both dynamos in series, making the working-pressure on each motor 400 volts. In the fifth position the contacts 1, 2, 4, 5, 6, and 7, line *e*, connect with the correspondingly-numbered terminals on line *g*. In this position the motors are in parallel and receive current from dynamo B. They are consequently working under 500 volts pressure. In the sixth position contacts 1, 3, 4, 5, 6, and 7, line *h*, engage with the similarly-numbered terminals on line *g*. In this position the motors are working in parallel, each under 800 volts pressure from the two dynamos in series.

In experimenting with compound dynamos connected in series in the ordinary manner Mr. Henry experienced much trouble, particularly so when they were of a different voltage. The difficulty was that the strongest machine overpowered the weaker and tried to run the latter as a motor and would do so unless the belt was very tight. To relieve this difficulty, Mr. Henry secured satisfactory results by coupling the dynamos up in the manner shown.

In the drawings, K represents the armature of the 300 volt or smallest dynamo. K' represents its series coil, and K² the shunt coil. L represents the armature of the larger or 500 volt dynamo, L' its series, and L² its shunt-coil. Instead of connecting the shunt-coil across the armature terminals of each machine the shunt-wires of both dynamos are put in series and their other terminals connected to the points of the combined machine having the greatest potential difference.

BRAKES FOR ELECTRIC TRAINS.[1]

With the use of electric locomotives on trains of three or more cars, run at considerable speed, has come a problem in brakes that must receive immediate attention—the design of the air pump. The brake mechanism is divided into two distinct parts, the air pump and the devices to control the air after it is stored. The Westinghouse quick action automatic brake is as well adapted for this class of work as for any other, but with it, as with all compressed-air brakes, the air must be pumped into reservoirs. The vacuum brake cannot be used with electric locomotives, as there is no steam to use in the ejectors and it is not practical to pump a vacuum for this work. The electric brake is still ahead of us and all such devices now offered are experimental for more than one car. As it stands to-day the only developed brake for electric cars is the compressed air brake, and with it has come the problem of the electric pump and governor.

On the Nantasket Beach and the Mount Holly electric roads, where the automatic compressed-air brake is used, there has been much trouble with the air pumps and governors. They have been noisy and unreliable, but recent changes make them promise better, and it may be expected that there will soon be a suitable electric air pump. Several are now offered in the market, and the Westinghouse Air Brake Company is bringing out one on a new plan.

With the electric brake the power is at hand, but the devices to use it are crude and troublesome. No doubt, all roads using the compressed-air automatic brake will prefer to continue it when changing to electric power, for the reason that the cars will not have to be changed, and further, because the devices used with that brake are practical and well understood. So far all new elevated roads but one, and all surface steam roads, have taken the automatic air-brake in making a change to electric power. The single exception is the Metropolitan Elevated of Chicago. Much to the surprise of engineers generally, this road started with an undeveloped and experimental non-automatic brake, and with the intention of running six cars on the fastest time and shortest headway ever accomplished on an elevated road. The constructors of the road even ridiculed the use of the automatic brake on the Alley elevated. For this reason, as well as because of the wish to see a safe device used for public conveyances, the selection of the automatic brake for the Lake Street and the Northwestern elevated roads of Chicago pleases those who had a part in fixing upon that device for the Alley elevated.

The new and almost untried device on the Metropolitan, which has been used before only on the Intramural road at the World's Fair, has more parts and is more complicated than an automatic brake, one feature being two distinct and separate brake cylinders to do the work done heretofore by one cylinder in all common forms of both automatic and non-automatic air brakes. As a result, the Metropolitan has had much trouble. The brake has had no suitable governor and therefore the pressure of the shoes against the wheels has been dependent upon the diligence of the motormen. For this reason there have been many slid flat wheels and an occasional collision with a bumping post. The officers of the road will try an electric brake as soon as some experiments that are in progress are completed; but this is somewhat doubtful, as a satisfactory electric brake for five and six-car trains is not being offered in the market now and there is little promise that there will be one soon.

AN ILLUMINATED CAR PARADE FOR CLEVELAND.

CLEVELAND, O., is to celebrate its centennial in June, 1896, and it has already been decided to make an illuminated trolley car parade one of the special spectacles, the parade to include illuminated floats illustrative of the local industries. Thousands of arc and incandescent lights will be specially used.

1. *Railroad Gazette.*

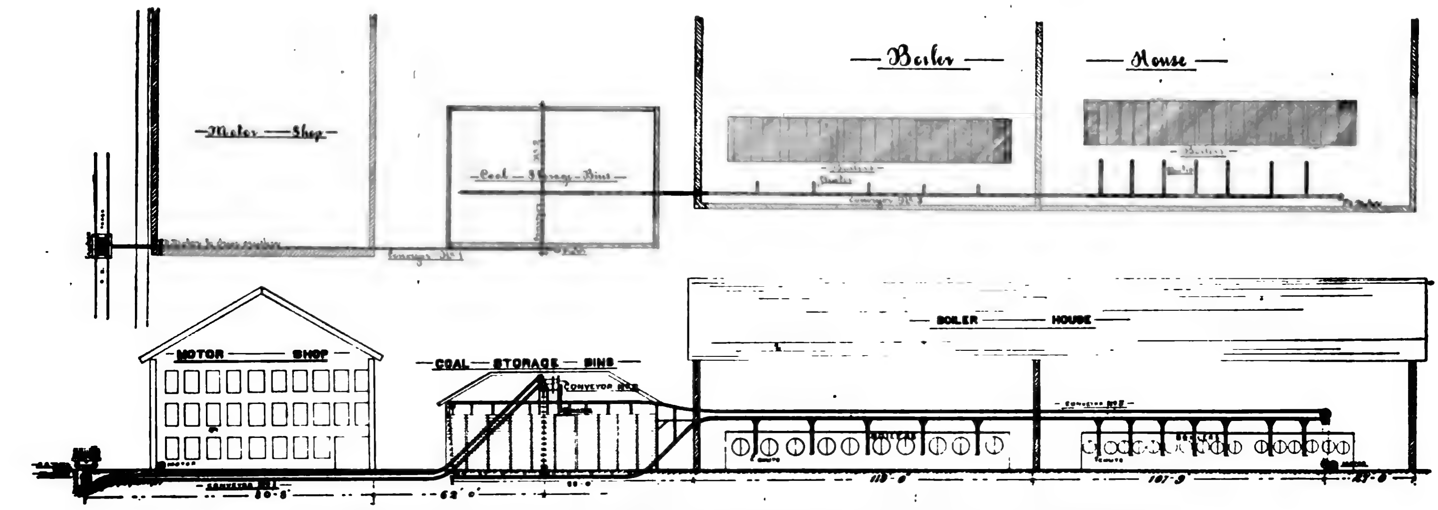
COAL HANDLING PLANT OF THE TORONTO RAILWAY CO.

Next to cheap coal itself the cost of handling it forms an important item in the operating expenses of electric light and railway power stations; as a result we notice a steady increase in the number of stations installing special coal handling machinery. The most recent and example of this kind is the coal handling plant arranged and built by the Borden & Selleck Co., of Chicago, for the Toronto (Can.) Railway Co.

This plant, which is illustrated in the accompanying engravings, is designed to carry coal from the car direct to the boilers or to the storage bin. A crusher of forty tons capacity per hour is placed under the track, in a steel tank, and is driven by a motor in the motor shop. The coal is dropped from hopper bottomed cars into the crusher and crushed into cubes not exceeding three inches. It then passes into conveyor No. 1, is carried under the motor shop and up the incline where it is discharged into conveyer No. 2, which in turn discharges the coal into the storage bin. Coal can also be discharged from No. 1 into No. 3 line, and conveyed direct to the boilers. The coal can be fed from the storage bin into either No. 2 or No. 3 lines, as desired, and through No. 3 to the boilers.

Spouts with valves are so arranged in the boiler house that coal can be delivered at any desired point, all valves being operated from the ground floor of the boiler room.

The Harrison conveyor, wheel system, with ¾ inch long and short link chain is used on the entire plant. No. 1 line chain is 300 ft.; No. 2 line 216; No. 3 680 ft. in length. On this style of conveyor all the wheels are of the adjustable segment style. The plant can be operated by one man, thus reducing the cost of storing coal and of supplying boilers to the minimum.



Coal Conveyors and Storage Bins, Toronto Railway Co., Plan and Elevation.

STREET-CAR ADVERTISING.[1]

The annual expenditure for street-car advertising in the United States has, in five years, grown from $300,000 to $3,000,000, and is constantly increasing. It is a field curiously liable to be cornered. In fact, every other vehicle of advertising has a quality of elasticity that is entirely lacking in the street-car method. New lines will not be started, nor even more cars put on, to give opportunities to advertisers. Those things are determined by the requirements of local travel. And when the sixteen advertising spaces in a car are filled, the seventeenth advertiser who comes along will have to wait his chance for some one else to drop out. Not infrequently the limit of accommodation has been reached in Boston and other New England cities peculiarly favored by advertisers, and applicants for space have had to wait for the expiration of running contracts before they could gain entrance. Already half a dozen firms are spending from $75,000 to $100,000 a year each in this way, at least twenty concerns each expend from $45,000 to $75,000, and from twenty-five to thirty may be counted who put out from $25,000 to $40,000 each. These sums, it is understood, are paid for the actual rental of spaces in the street cars, the placing of the cards in them, and the watching necessary to see that the cars are run according to to contract. The cost of getting up the cards, which is very considerable, is outside this estimate. To make up the remainder of the estimated $3,000,000 of total annual expenditure, an army of smaller advertisers, generally local only, lend their aid.

1. Abstract from *New York Sun*.

The growth of street-car advertising has been to a very marked degree dependent upon and synchronous with marked improvements in street-car service. It was a very insignificant interest in the old days of the horse cars, prior to 1878.

It was not until 1888, when electric propulsion had been clearly demonstrated to be commercially practicable, and trolley lines were put in operation all over the country, that street-car advertising began to assume its present character.

The street-car companies derive a handsome revenue from the leasing of their advertising spaces. One corporation, controlling several good lines in a neighboring city, receives annually $75,000 from this source, and over $65,000 annually is paid for the advertising privileges of the Boston street cars. But Boston is deemed by advertisers an exceptionally desirable field for them. It is indeed considered the best city in the country from this point of view and Philadelphia ranks next. Chicago is third.

As a whole New York does not rank high in the category of the advertiser's choice. For $600 one can put a card in every street car in Boston and keep it there for a month. For a similar sum he can cover Philadelphia in like manner. But to put a card in each New York street car, including those on the elevated railways, for a month would cost from $1,800 to $2,000. Consequently, advertisers are generally in the habit of making contracts only covering certain specified lines of New York cars and shifting about from one to another.

As a rule, all over the country the advertising privileges of street-car lines are primarily leased to local speculators, who sublet the spaces, so far as possible, to local advertisers. It is seldom practicable for them to fill more than one-third, or at most one-half, of the sixteen spaces in each car by the exclusively local patronage they are able to command. Then, as they would lose money by allowing the remaining spaces to remain empty, they are anxious to lease on whatever terms they can get all that are left. It would be difficult, if not impossible, for the local speculator in car spaces to deal directly with the big general advertisers, who are scattered all over the country and would not be bothered by a multiplicity of small local contracts, the faithful keeping of which they could in nowise be assured of. He must, therefore, seek an intermediary possessed of the capital to buy his space, the courage to take the risk of filling it, the influence to do so, and the system to make sure of getting all the service it contracts for. This is the field of a corporation which now controls all or a great part of the advertising space in 11,880 cars—in New England, 1,551; Middle States, 3,807; Southern States, 1,494; Pacific States, 970; Western States, 4,306, and Canada, 222. Three-fourths of those cars are on trolley lines, and very few, in the smallest and most remote places, are drawn by horses.

Some difficulty was, at the outset, encountered in the concentration and systemization of all these local fields for the use of the general advertiser, in consequence of the various sizes of car spaces, which necessitated a multiplicity of cards, of divers forms and dimensions. Now, however, car builders have adopted a uniform scale of sixteen card spaces each 11 x 21 inches, which gives ample opportunity for handsome display. And it is indicative of the rapidity with which these handsome, big modern cars have supplanted those of older types, that only about 9 per cent. of the cars now in use have the old spaces 10 x 24 inches. Helena, Mont., maintains still an exceptional dozen having the odd size of 12 x 18 inches. This is a more important matter than might readily be recognized, since many of the cards now prepared for street car display are expensive litho or zinc prints, in colors, artistically designed in form, and balanced in tints and

shades to give as much effect as possible. To make them of various sizes would impose an almost prohibitive increase upon their cost.

To have assurance that the cards of its advertisers appear as contracted for, the corporation referred to maintains agents in 127 cities, whose duty it is to keep watch upon the car service and make frequent reports of the most elaborate character, setting forth every fact of possible interest in full detail and with the nicest exactitude. The number of each car upon every line in which an advertiser's card appears, the number of days it is in service during the month, and the number of its runs a day and number of passengers carried, any omissions that may occur, the excuses offered for them, and the compensatory service rendered, are only some of the matters covered by these reports.

OPERATION OF THE LIVERPOOL ELEVATED ELECTRIC ROAD.

At its last half yearly meeting, the Liverpool elevated electric road declared a dividend of 5 per cent. per annum on the preference shares and 2½ per cent. on the common shares. Mr. Forwood, chairman, stated that their number of passengers had increased from 2,861,437 to 3,460,060 in the past half year. Looking at these figures a little more in detail, there had been a very satisfactory increase in the number of first-class passengers. The number had increased from 277,658 to 400,260, and there had also been a very satisfactory increase in the number of second-class passengers. The number had gone up from 1,246,975 to 2,114,462. Their gross receipts amounted to £28,082, against £20,011 in the corresponding half of last year, showing an increase of £8,071. The gross expenditure had been £18,658 as against £14,947, or an increase of £3,711; that was to say, they had earned an increased revenue of £8,071, of which they had spent in earning it £3,711, but part of that expense had gone in the increased mileage. The increase in the running was 46,000 miles, and they had worked 16 stations instead of 14, consequently, they had had the additional expense of two stations. Their traffic had continued to progress since those accounts were made up. During the six weeks which had elapsed since June 30 they had increased their traffic by 55,000 passengers, and had taken £1,568 more money than they did during the corresponding six weeks of last year.

The ratio of expenditure to their revenue had been 66.48 per cent., as compared with 74.69 for same half of last year. The ratio of the cost of their locomotive expenditure to net revenue was 24.26d., as against 21.28d. That was an increase of nearly 3d. This was due to their having had more repairs to effect to their motors than they had at the similar period last year, the long frosty winter being particularly trying to their motors. The proportion of their operating expenses to their revenue was 37.54d. as against 41.99. That was also a satisfactory feature, as showing that in proportion to their revenue their expenses had gone down. Their revenue per train mile had increased from 18.10d. to 21.65d, —that was to say, they had increased their revenue per train mile 3.55d. per cent. The expenditure per train mile had gone up from 2.88 to 3.49, an increase of 0.61d. While their revenue had increased 3.55d., their expenses had increased only 0.61 per train mile. In reference to the physical condition of their structure, it had never been in a better condition than it was at this moment. With respect to the Southern extension, that was to say, the extension from the Herculaneum Dock, the present terminus, to a point in Park-road near the Dingle, they had let the contract at a figure within the estimate made by their engineers, and he might say that the contractors were already very busy at work. The directory had every reason to anticipate that this new extension would be completed within the time stated in the contract—namely, 12 months.

A TROLLEY ROAD INTERESTING TO THE C., H. & D., THE O. S., THE S. H. V. & T., THE B. & O. S. W. AND OTHER ALPHABETICAL ANTEDILUVIANS.

The new electric road from McArthur to Jackson is going to have a rocky time getting over the last half of the proposed route. Injunctions in plenty have already been gotten out at Jackson and Wellston. No stone is being left unturned by the C., H. & D. and Ohio Southern to stop the road. This opposition on the part of the railroads is due to the belief, for which there is more than a little ground, that the proposed electric road is nothing more or less than a blind put out by the C. H. V. & T. to secure a line parallel to their track through the Jackson-Wellston coal district. At Wellston the Ohio Southern has raised its main track several feet at points where the electric road would cross. The C., H. & D. has lowered its main track three feet and raised its side tracks four feet. Both roads are throwing out switches in all directions to prevent the other road getting through. Tracks have been lowered and raised until the Wellston yards are nothing but cuts and embankments. Two ways are left for the electric road to get through. It must either bridge over or tunnel under the railroad tracks. The B. & O. S. W., as yet, takes no hand in the work of obstruction. It is holding its forces in reserve, and when the time comes will probably be able to do more effective work than both the other roads put together. Iron taken from Hocking Valley switches and hauled in Hocking Valley cars is being delivered to rail the electric road with. The promoters of the line are working away steadily getting their roadbed in shape. They expect to soon commence laying rail on the McArthur end from which point to Hamden there is little or no opposition.—*Chillicothe, O., News.*

PROTECTING A TROLLEY CROSSING AT CAPE ELIZABETH, ME.

The Maine railroad commissioners have rendered decision on the crossing of the Cape Elizabeth railway with a division of the Boston & Maine. Near Cape Elizabeth is South Portland. In line with their policy to better protect crossings they order that a mast and signal ball and light be established at this point, the expense of erection to be borne by the electric company, while the expense of maintenance be borne equally by the two corporations, no electric car to be allowed to cross track until the ball or light be displayed.

It is the intention of the commissioners, if petitioned, to establish like signals at all dangerous crossings of electric and steam railroads.

NEW HAVEN, CONN., REPORT ON CAR FENDERS.

The common council ordinance committee of New Haven has submitted to the board of councilmen an interesting paper on the subject of fenders for electric cars.

The chief points in it are as follows:

"We believe that a combination of a good platform fender and a good automatic wheel fender should be required on the forward part to each motor car, the platform fender which extends out in front of the platform for catching persons struck while in a standing position, and the wheel fender which is underneath the body of the car for picking up or keeping from being crushed by the wheels persons lying prostrate.

"A car equipped with only one of these two classes of fenders we would consider to have very incomplete and insufficient protection, the chances being, if equipped only with platform fenders, that a person lying flat would go under the car and be crushed by the wheels; and if equipped only with a wheel fender, that a person struck while standing would probably be dashed to the ground receiving perhaps fatal injuries by the force of contact with the pavement.

"Therefore, to provide for both emergencies, a combination of the two classes of fenders should be required on cars, the platform fenders to be so arranged that they will yield and pass over a prostrate body without injury."

The committee recommends that "the platform fenders hang not less than eight nor more than ten inches from the top of the rails and that the automatic gate or tripper of the wheel fenders hang not more than six inches from the top of the rails, the fenders to be always in perfect working order and in good repair." In the opinion of the committee the best platform fenders are the Darrach of Newark, N. J., and the Barrett of Boston, and that the best wheel fender is the Darrach.

In view of the fact that the railroad commissioners have the exclusive power to order fenders, the report of the committee will very probably be wholly ineffective.

CONSOLIDATING THE PITTSBURGH STREET RAILWAYS.

There is said to be a movement on foot, which is expected to be consummated at once, providing for the consolidation of all the street railways in Pittsburgh. Capitalists of New York, Philadelphia and Pittsburgh are interested in the scheme, and if carried through, more than 200 miles of street railways will be under one management, involving a capitalization of about $25,000,000 On the roads there is said to be a funded debt of about $10,000,000. The plan has been under way since the enabling act was passed by the recent Legislature. The moving spirit is understood to be Chris. Magee, while P. A. B. Widener and William L. Elkins are associated with him. A number of New Yorkers are expected to become stockholders. The roads mentioned in the proposed consolidation are the Pittsburgh, Allegheny and Manchester Traction, Duquesne Citizens' Traction, Federal Street and Pleasant Valley Passenger Railway, Pittsburgh and Birmingham Traction, Central Traction, and the Second Avenue Passenger Railway Company.

ARMING MASSACHUSETTS TROLLEY CONDUCTORS.

The directors of the Gloucester, Essex & Beverly Street Railways have ordered their conductors to arm themselves with revolvers. It is feared that highwaymen may attempt to hold up the company's cars late at night, in some of the lonely spots with which the road abounds.

THE SPECIAL TRAIN FROM NEW YORK TO THE MONTREAL CONVENTION.

Arrangements have been made for a special train via New York Central & Hudson River Railroad Company for the accommodation of delegates and others attending the Montreal Convention of the American Street Railway Association, which opens Tuesday, October 15, at 10 a. m. The special train will leave the Grand Central Station, 42d street, Monday, October 14, at 6 p. m., arriving in Montreal Tuesday morning, October 15, in time for breakfast. A dining car will be attached to the train leaving New York.

Passengers from all points West can connect with the Special at Utica, N. Y., Monday night, by leaving the following cities at the hours mentioned: St. Louis, 7.55 p. m., Oct. 13, via "Big Four"; Cincinnati, 8.25 p m., Oct. 13, via "Big Four;" Toledo, 9 a. m., Oct. 14, via Lake Shore; Cleveland, 12.50 p. m., Oct. 14, via Lake Shore; Detroit, 9.40 a. m., Oct. 14, via Michigan Central; Buffalo, 6.50 p. m., Oct. 14, via New York Central; Rochester, 8.43 p. m., Oct. 14, via New York Central; Syracuse, 10.50 p. m., Oct. 14, via New York Central.

Arrangements are being made for a daylight return trip through the beautiful Adirondack scenery, including a stop at Lake Saranac.

The special rate of a fare-and-a-third for the round trip has been granted, making the cost of a ticket from New York City to Montreal and return, $13.35. Tickets should be bought from all points on the certificate plan, the purchaser taking a delegate's certificate from the ticket agent, which, when properly countersigned at Montreal, will entitle the holder to a return trip at one-third the regular fare. Wagner Sleeping Car accommodations will be provided at the usual rate of $2 per berth from New York City to Montreal.

The Committee in charge respectfully urge all who intend to take this special train to reply at once in order that ample accommodations may be provided and proper assignments made.

Inquiries relating to the reservation of berths, tickets, etc., should be addressed to M. C. Roach, General Eastern Passenger Agent, 413 Broadway, New York, or any member of the Committee, which consists of John N. Partridge, Chairman, Secretary American Street Railway Association, Brooklyn, N. Y.; Jas. H. McGraw, Havemeyer Building, New York; Charles W. Price, 13 Park Row, New York.

TROLLEY EXTENSION IN RICHMOND, VA.

Colonel Cutshaw, the City Engineer, has returned to Mr. A. Langstaff Johnston, chief engineer of the Richmond Traction Company, the street plans for the proposed Broad-street railway. The Engineer made such changes and suggestions as he deemed necessary, and Mr. John Skelton Williams says that work on the road will begin within the current week, which is, he says, the limit allowed the company by the city.

TAKE YOUR CHOICE.

A distinct admission has been made by the trolley-car companies that they purposely reduced their speed below the limit set by law, after the rates of six and eight miles an hour were set, in order to create a public sentiment in favor of faster speed, by the recent increase, which it is claimed does not infringe the ordinance. It was found that the low rate of speed was detrimental to the best interests of the companies, and as they had failed to secure a sufficiently strong public sentiment to obtain a modification of the ordinance, it was decided to send the cars along a little faster. It remains to be seen whether fatalities follow in the train of the more swiftly moving cars.—*N. Y. Evening Post.*

Charles F. Franklin, chief inspector of the speed of trolley cars, made a report to the mayor's office of speed violations for the past month. The Brooklyn Heights railroad was guilty of 58 violations; the Atlantic avenue, 29; the Brooklyn, Queens County and Suburban, 11; the Coney Island and Brooklyn, 7, and the Nassau Electric, 4, making a total of 104 violations. The Brooklyn Heights road ran one of its cars at a rate of 22 66-100 miles an hour on Fulton street. Mr. Franklin says there was a test of three speed regulators during the month, two of which indicate speed, but do not govern the motor.—*Brooklyn Eagle.*

A TROLLEY AMBULANCE FOR BOSTON.

The trustees of the Boston city hospital have about made up their minds to try the ambulance trolley car, and when they think the finances will admit of this experiment, arrangements will be made to operate one in Boston. The advantages of the trolley ambulance over the wagon now used are many. In cases of a transfer from a warm house to the hospital, the patient taken in the heated trolley car would not experience the shock in winter that he does when removed to the hospital in the ambulance wagon.

TEST OF ELECTRIC CARS IN HAULING FREIGHT ON THE NANTASKET SYSTEM.

Electricity as a motive power and its practical use in handling freight on railroads were tested last week on the Nantasket beach electric system of the New York, New Haven and Hartford Railway. The experiments were made with motor cars and flat cars heavily freighted with Quincy granite, and were witnessed by a large number of the railroad officials, who regarded the tests as satisfactory and indicative of a revolution in railroad traffic within a few years.

Two-motor car No. 2,503 was first tested with a load of nine cars with a combined weight of 302 tons. As this load was too heavy the cars were dropped off, one at a time, until only five remained. which were drawn fairly well. Then the four-motor car No. 2500 was ballasted with 5,000 pounds of iron and attached to seven loaded cars weighing 234 tons. It drew the load easily and there seemed to be no great effort when the load was increased to eight cars and 273 tons, and afterward to nine cars and 303 tons. Then the motor car ballast was increased to five tons, and the car easily pulled ten car loads of freight weighing 335 tons. Twelve carloads weighing 400 tons were also handled without difficulty, but with fourteen cars, weighing 470 tons, the train moved slowly, as it was exerting a power equal to that of a forty-two ton locomotive. The two motor cars were then coupled together and attached to various loads up to thirty cars, weighing 954 tons, which were successfully hauled. While making this test something gave out on the four-motor car, and the less powerful car handled the entire load. Then the two-motor car was attached to six cars weighing 215 tons, and carried them to the Nantasket yard.

Tests were also made with the open motor cars, one of which, with a single motor, easily hauled a carload weighing thirty-nine tons to the power station and return, subsequently hauling two cars of forty tons each. At the conclusion of the freight power tests the gentlemen present were treated to an exciting exhibition of the speed of electric cars. An open car was run down to Pemberton at a speed of fifty-eight miles an hour. On the return the car was sent spinning along with a velocity of seventy-two miles an hour. President Clark of the New Haven Railroad expressed himself as much pleased with the results of the tests. He said that electric cars at frequent intervals can haul freight cheaper and better than it can be done with steam. He also intimated that the railroad of which he is president will soon adopt a system of suburban electric traffic, and he thought the people of the South Shore will be given an opportunity, within two years, of riding to Boston on electric cars.

TROLLEYS ON THE BROOKLYN BRIDGE.

The bridge trustees have adopted a resolution instructing Chief Engineer C. C. Martin to investigate "the question of electric motive power for the propulsion and switching of the trains on the bridge," and to obtain from the various electrical companies plans and specifications. It is believed that the trustees have decided to put in some electrical system in place of the engines now in use.

MORE ELECTRICITY FOR THE N. Y., N. H. & H.

It is stated, on excellent authority, that the New York, New Haven and Hartford Railroad will at once commence to equip that portion of the road from Cohasset, Mass. to Braintree, a distance of about 15 miles, for running by electricity in connection with the Nantasket Beach branch. Engineers are at work at present taking measurements.

ELECTRIC RAILROADING IN PERU.

A representative from the Baldwin Locomotive Works, with an expert electrician from the Westinghouse Company, together with Sir Henry Tyler, ex-President of the Grand Trunk Railway, have left for Peru, where, it is said, a test of the possibility and feasibility of the electric locomotive is to be made upon a railroad 15,000 feet above the sea level. Sir Henry Tyler was recently in Philadelphia for several days in conference with members of the Baldwin firm on the subject.

The name of the Company proposing to make the test could not be ascertained. It is said that should the report of the representatives of the Baldwin-Westinghouse experts be favorable, it will probably lead to the placing of the first large order for the new locomotive. The proposed experiment will be watched with great interest by railroad men throughout the country.

The Baldwin Company is to be represented by Arthur Church of Philadelphia, and J. Blunt, of Pittsburgh, will look after the interests of the Westinghouse Company.

CHICAGO, imitating other cities, has adopted the practice of trolley funeral trains, the Calumet Electric Street Railway being the road to initiate it.

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CONTENTS.

SUPPLEMENT.

RAILWAY SPEEDS.

THE recent speed contest between the two railways connecting London with Aberdeen, and the new record made by the New York Central between New York and Buffalo, show that it is possible to run trains hauled by steam locomotives at a speed averaging 65 miles an hour, including necessary stops, over distances exceeding 100 miles. We will not undertake to enter into a discussion of the difference in load as between the American and English trains with which these speeds were attained, leaving this to the adherents of the steam locomotive; but some statements appearing in *Locomotive Engineering* and bearing on the relation of the speeds recently attained to those obtainable by electric traction seem to call for some comment. The journal above mentioned, edited by the well known locomotive expert and engineer Mr. Angus Sinclair, while admitting the feasibility of electric traction on suburban business where light and frequent service is needed, still considers the problem of the larger and heavier work an unsolved one; and here are its arguments in support of its assertion:

> The electric current is only a convenient means of conveying power—a belt—and that power can be best and most economically developed by a steam engine. Further research develops the fact that it is quite impossible to send this current over a trolley wire for more than five or six miles with any economy—the current leaks away and becomes weak. The longer the line the weaker the current towards the outer end, and the higher or stronger the current the more it leaks.

Mr. Sinclair is also quoted as saying that electricity has no chance for long distances, because such tremendous powers as are required in high speed locomotives have never been transmitted by electricity. He admits, however, that if it were possible to give an electric locomotive 1,200 H. P. a steadier speed could be got than by the steam locomotive. Such statements appearing anonymously in the daily press would scarcely call for serious refutation, but appearing in a recognized technical journal and coming from so well known an authority, they would seem to require more than passing notice. Can it be that Mr. Sinclair has not heard of the numerous power transmission both here and abroad, some of which reach thousands of horse power over distances exceeding 20 miles? We need only to refer to the most recent example, the Folsom-Sacramento plant. But to come more directly to electric railroading, our contemporary seems to be unaware that in not a few instances electric cars are now being operated by current transmitted 25 or 30 miles from the power house, with all the fatal "leaks" and without becoming too "weak." As to the statement that *if* an electric locomotive could be built having 1,200 H. P. it would be superior to the steam locomotive, it so happens that the electric locomotive now running in the Baltimore Tunnel, and its two mates now nearing completion at Schenectady, are designed to exert exactly that power. Can it be, that the author above quoted was in ignorance of all these facts? If so, it indicates a strong and perhaps natural tendency of the old steam locomotive engineers to overlook or ignore the steady march of progress in electric railroading, and to blind themselves to the inevitable. Be the cause what it may, the fact remains that no locomotive engineer to-day can afford to despise the electric railway side of his work. It is a mistaken idea to imagine, as our

contemporary seems to do, that electric railroading presents a "problem" like the direct conversion of heat into electricity, upon the solution of which some one may stumble overnight. On the contrary the great principles of electric railroading are matters of common technical knowledge and it is now merely a plain question of adapting simple means to reach a given end,—in other words, ordinary evolution.

THE NIAGARA-BUFFALO DEADLOCK.

While far Sacramento has been celebrating with brilliant festivities her utilization of power brought twenty-two miles, and while Salt Lake City is getting ready with alacrity for the transmission from the Big Cottonwood, which is to do so much for her industries, poor Buffalo that has counted fervently upon the coming of the power from Niagara to make her the first or second city in the Union, is to-day, it would seem, further than ever from realizing her just hopes. For years past, Buffalo has looked upon herself as *the* city to be benefited by the utilization of Niagara, yet to-day with two 5,000 H. P. generators running at Niagara and a third being put in position, Buffalo might as well be Boston, for any good the power is doing her.

It seems to us that this is a most regrettable state of affairs, for Buffalo is the natural destination of a large part of the energy developed electrically at the Falls; but the Power Company and her Aldermen cannot hit it off at all, and the latest form of proposed contract has just been rejected. The main points that are objectionable in the unfortunate franchise are: The clause requiring the Company to construct and maintain poles and conduits sufficient for at least two other companies; the exaction that all wires may be ordered under ground at any time, which might be immediately after the poles were erected; the demand of an annual tax of five per cent. on the gross receipts; the limitation of the grant to 25 years, whereas the Company's bonds are 36 years, and the right to revoke the grant on 10 days' notice, which would obviously forbid the investment of capital.

That the Company should object to such conditions after an investment of millions of dollars, and with a steady and growing demand for power outside Buffalo, is natural; and we do not see how it could do otherwise, although our sympathies are entirely with the citizens of Buffalo in their anxiety to make decent terms and get the power that their eyes and hopes have now been fixed on for years.

CONDUIT RAILWAY OPTIMISM.

The exhibition of optimistic sentiment over the partial success obtained by the short stretch of conduit road on Lenox Avenue, New York, is in its way, quite amusing. One would think that a new demonstration had suddenly been made of some unsuspected virtues of electricity and that hereafter, in consequence, the trolley is a doomed thing. The work in Buda-Pest is vastly more successful so far than that in New York, but it would not clinch the argument for the abandonment of the trolley in America. We believe the trolley to be good for another half century at least, with many elements in its favor, at the worst, that an open slot conduit system, at the best, does not enjoy. Moreover, the closed conduit has been unfairly overlooked in all this hurrah, which is based apparently on the cheery utterances of Mr. John D. Crimmins, who said that after a bare six weeks' running of Lenox Avenue, in the height of summer, the Metropolitan Company had "*determined* that the saving in operating expenses is four cents per car mile as compared with cable traction and eight cents per car mile as compared with horses." We only wish this were true, but neither Mr. Crimmins nor any other man can find out such a state of facts in six summer weeks.

Besides, as we have just intimated if it is to be more conduit—a consummation certainly to be hoped for—let us have some of the closed conduit. The Lenox Avenue road lying in a broad plain, is naturally difficult to drain and smells offensively at certain points near the sewers. Moreover, the clouds of dust emitted are at some points positively sickening. Large numbers of men are often at work on it, and we are told that one plow a day is the average of destruction, although many forms have been tried. Besides, it will be remembered that already the radical departure has been made of suspending the conductor bars from the roof of the conduit instead of holding them up on pillars. It would, therefore, be better for everybody to wait a winter, before bursting out in vociferous congratulation.

If the open conduit problem is settled, we hardly think Mr. Westinghouse would be so foolish as to push the Wheeless closed conduit system which his company has lately acquired. There is also the Johnson-Lundell system which for those who have seen it possesses many merits worthy of practical trial on a large plan. We have also heard it stated that the closed conduit systems are much less expensive to build and maintain than the open—which seems quite possible; and if so, many smaller cities must look to the closed conduit as a means of relief from the trolley. Any one can see that the Lenox Avenue road is a very costly piece of work, and we imagine that economy in construction will still be a material point with those who invest their capital in such enterprises.

OLD TIMERS.

New York City the past week has been enlivened pleasantly for many of us by the presence of the Old Timers, met with the U. S. Military Telegraph Corps for their fifteenth reunion. The affair was well handled, and though no serious business can be said to have been transacted, the three days were by no means spent amiss or unprofitably. The real Old Timers, one cannot help noticing with a feeling of sadness, begin to thin out. Nor is this to be wondered at, for telegraphy is a most exhausting occupation, even for energetic youth. The work is sedentary, the nervous strain is high, the hours are long and the pay is meagre. Some figures recently collected in England tell a grim story. Out of 100 deaths among all adult males in England 13.8 are due to consumption; out of 100 deaths among the grinders in the cutlery trade who are specially subject to the disease, 33.1 are due to it, while the proportion for the telegraph operators is 46 6 in 100. More than half of them die of diseases of the respiratory organs, against 24 per cent. only in all other occupations. This is serious but may perhaps be explained by the fact that the more active men get out of the business early, and that the weaker men struggle on at the key till stricken down. Be this as it may there are many lusty old timers in America still engaged at the fascinating drudgery or else making their fortunes away from it; and to them all a reunion such as was participated in last week can but be productive of good. The art is so young even now that the rising generation in it may well be stimulated to higher endeavor by meeting the pioneers and deriving from them some of the enthusiasm and fortitude with which the foundations of telegraphy were gallantly laid.

Electric Lighting.

WHAT AN ARC LAMP COSTS PER YEAR.

The Albany, N. Y., City Council has been discussing prices of city lights, and has had before it, at public hearings, such men as Mr. M. J. Francisco, Mr. John Moore and others, who had little difficulty in destroying the fictitious figures presented as to much of the municipal plant work in this country. Their statements were supplemented by the following data from Judge A. Hamilton, as to the usual cost of operating and maintaining an arc lamp per annum:

"It is well settled from experience that for every 2,000 candle power lamp, burning all night every night, or 4,000 hours, four pounds per hour for twelve hours, which includes the starting and drawing of the fires, or eight gross tons of coal per year will be required. In Albany this would cost at $3.30 per ton, $26.40 per lamp for coal each year. (In Chicago where coal costs $1.85 per ton delivered, the cost of coal per annum per lamp is $25.68.)

"The items of cost are per lamp per annum:

Coal	$26.40
Carbons, 8½, per night per lamp per annum	12.00
Oil and waste, per lamp per annum	8.50
Repairs to lines, dynamos, engines and boilers	7.00
Office expense, printing, telephone, freight, etc	1.50
Stable maintenance	1.00
State and local taxes and water rates	1.67
Pumping station ($2,000)	3.33
Insurance	2.00
	$58.40

"The wages account for labor, exclusive of salaries for officers, in Chicago is $51.88 per lamp; by Philadelphia estimate would be $43.28, and by account of Topeka, Kan., is $33.66 per lamp per annum.

"Excluding the repairing and cleaning of the lamps, the cost of labor, including salaries here, is $28 per lamp per annum.

Supplies, per lamp per annum	$58.40
Labor, per lamp per annum	29.00
Total	$87.40

"To this add the following:

Depreciation at 5 per cent. on $250,000	$12,500
Interest at 5 per cent. on $250,000	12,500
	$25,000

Or per lamp per annum	$43.33
Coal, etc., and labor, per lamp per annum	87.40
Total cost per lamp per annum	$130.73

"The highest price fixed in the Albany ordinance is equivalent to $131.40 per lamp."

Judge Hamilton took up seriatim the statements made and showed that in 101 cities and towns of the United States having an all-night service of 2,000 candle power, the average annual charge for each lamp was $150 72, against a proposed charge in Albany of $131.40. He insisted that the Brush system was not only the best but the only good system. The local company had the local field for the Brush light, having secured it by paying $30,000 in cash and surrendering its privileges in Rensselaer county.

STORAGE BATTERIES IN A ST. LOUIS DRY GOODS STORE.

The Electric Storage Battery Co., of Philadelphia, has recently closed a contract with the Barr dry goods store of St. Louis, for a battery of 58 Chloride accumulator elements, type F-11. This battery has a capacity of about 100 16 c. p. lamps and will be used for carrying the lamps required by the sweepers and watchmen during the night after the dynamo has been shut down.

THE PROPOSED CITY PLANT FOR MILWAUKEE, WIS.

City Engineer Benzenberg, of Milwaukee, after examining in all its bearings the wisdom and the propriety of constructing a city electric light plant, has come to the conclusion that at the present time it would be unwise to attempt it, as there is no money in the treasury for that purpose nor can a sufficient amount be obtained by the issue of city bonds. Mr. Benzenberg speaks thus emphatically: As regards the financial ability of the city to build its own plant now, that is absolutely out of the question. At a minimum estimate, it would cost the city of Milwaukee $400,000 to build and equip an electric light plant. The only way in which this money could be raised would be by increasing the bonded indebtedness of the city to a sum sufficient to meet the expenditure and this cannot be done for the reason that city bonds have now been sold to within $150,000 of the constitutional limit which provides that the total indebtedness of a city shall not exceed 5 per cent. of its assessed valuation.

THE "DEADLY SHADE TREE" AT MAMARONECK, N. Y.

William D. Palmer, of Mamaroneck, N. Y., has obtained judgment in Justice Marshall's Court against the Larchmont Electric Company. The amount of damages awarded him was $150. Mr. Palmer had in front of his house a number of handsome shade trees. The electric company in stringing cut away portions of branches of these trees. The suit was based on the allegation that the company cut the trees maliciously. The jury heard the evidence and then viewed the mutilated trees. The case will be appealed, as there are others who may bring suit if the decision is allowed to stand.

THIRTY-SIX TOWERS FOR WACO, TEX.

The Waco Gas Co. has put up, by order of the city council, 36 arc light towers on street corners, and the effect is said to be excellent. "The *Waco Times* reporter remembers when he went home after midnight in the middle of the street through Egyptian darkness and carried a rock in each hand to protect himself and his wealth from thugs supposed to waylay opulent and belated citizens. It was pretty tough. In summer the lightning bugs helped out a little and on the light of the moon it was simply immense, but when the moon failed and there were no lightning bugs it was dismal."

THE YIELD OF A WELSBACH BURNER.

L'Energie Electrique recently stated that, taking the yield of a Welsbach burner at nine candles per cubic foot of gas used, the same light may be obtained by burning a cubic foot of gas in a gas motor used to drive a dynamo; for with the motor 17.6 cubic feet of gas per horse-power per hour, and an efficiency of 85 per cent. in the dynamo, while the lamp uses 3¾ watts per candle, and lasts 800 hours, the quantity of power absorbed during the 800 hours is, for a 16-candle lamp, 48,000 watt-hours, or 64 horse-power-hours. This corresponds to 1,408 cubic feet of gas, or 1.76 cubic feet per hour for 16 candles, or 0.99 cubic foot per hour for nine candles, the same as the figure above given for the Welsbach. Forcing the lamp so that it has a shorter life gives, at the present prices of lamps, still better results. "But this," says the *Gas World*, "is surely the barest and baldest way of stating the problem. It may be that the cost of lamps may be set against that of Welsbach hoods; but there are other things to be considered besides the mere price of gas. And nine candles per cubic foot of gas in a Welsbach takes the Welsbach at worse than its worst; it is not even an average figure, while a steady light yield of 16 candles for 800 hours at 3¾ watts is not a well-known or common phenomenon."

A LONDON REFUSE-DESTROYING PLANT.

The contract has been signed for the building of a lofty chimney, constituting the first portion of a very spirited scheme which the Shoreditch Vestry are about to carry out. They have purchased a piece of land upon which the City of London Iron Works formerly flourished in the neighborhood of Hoxton Square, and upon this they are going to erect a dust-destructor on the newest principles. It has been abundantly demonstrated that the furnaces in which the refuse is destroyed may very advantageously be employed for the generation of steam or other purposes. The Shoreditch Vestry have resolved that in their parish the destructor shall do a double or rather a treble duty. It is to destroy useless refuse, to generate steam for lighting the parish by electricity and supplying electric power to those who need it, and at the same time it will afford a supply of hot water for public baths and wash-houses. The chimney-stack referred to will be the commencement of an experiment which it is believed will be unique. It will be 150 feet high, and around the foot of it will be the electric-light and power station, the baths and wash-houses, and on a corner of the same plot of ground will be a large and handsome public library.—*London Daily News*.

LIGHTING A LARGE FOUNTAIN IN BROOKLYN.

The lighting of the large fountain at the plaza at Prospect Park, Brooklyn, by means of electricity, makes an attractive feature of this ornament of the city. Years ago there were rows of gas lamps about the fountain, and it was fairly illuminated. They were afterwards removed and never restored. Under the last administration the Memorial Arch was lighted with electric lamps, but this has not been steadily maintained by the present Park Commissioner. He has, however, made arrangements with the trolley companies to supply the electricity needed for lighting the fountain.

Power Transmission.

CARD AUTOMATIC SAFETY LIMIT SWITCH AND RHEOSTAT FOR STARTING STATIONARY MOTORS.

The accompanying engraving illustrates the new safety limit switch and rheostat for starting stationary motors manufactured by The Card Electric Company of Mansfield, Ohio. This device is not only a perfect safe-guard against damage to the motor from open circuits on the line while the motor is running, but is absolutely reliable as a limit switch and may be adjusted for any per cent. of overload desired. The principal operating parts consist of two bar electro-magnets in circuit with the line armature; a double-pole switch with spring release; a resistance contact arm held normally at "off" by a flat coil spring and the usual contact points and building blocks.

Aside from the general excellence in design and construction of this starting box, its principal novelty lies in the arrangement of parts constituting the magnetic circuit. The two bar electro-magnets operating the releasing mechanism are provided with pivoted armatures at each end, common to both, the lower one acting as a yoke when closed, forming with the two cores a simple horse shoe magnet; this armature or yoke is, however, so pivoted that should the current from any cause cease to flow through the line while the motor is running, the spring provided for throwing the double pole switch will instantly be released and trip in turn a catch holding the swinging arm that will be thrown "off" over the contact points, cutting the resistance in and placing all parts of the apparatus in proper position for starting again. An overload pulls the upper armature down, releasing the detent holding the switch closed, and that, with the swinging arm is constantly thrown to "off" the same as for no current.

The magnets of this switch differ from other automatic switches in having but one coil of heavy wire, of few turns, carrying the full current of the motor. There are no fine wire

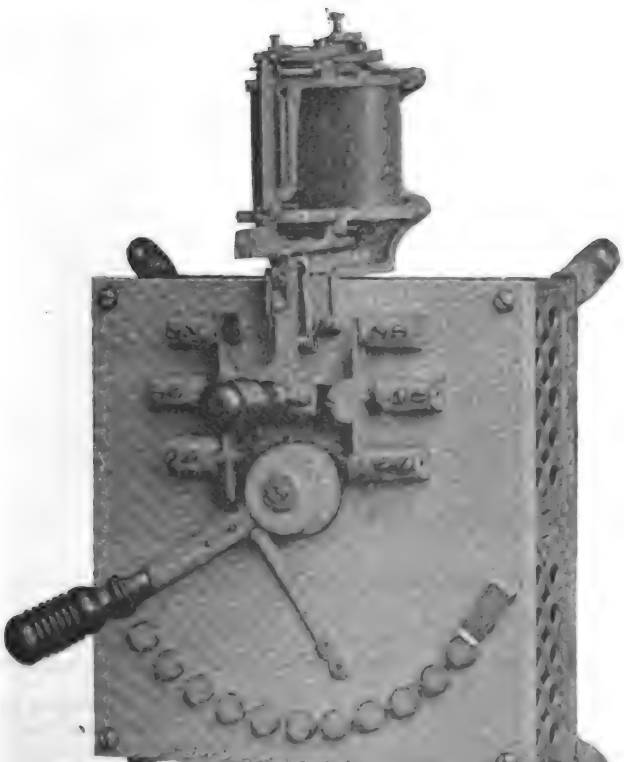


Fig. 1.—Card Automatic Safety Limit Switch and Rheostat.

coils or differential windings to give trouble and cause unreliable action. The work of releasing the catches is done direct and in the simplest possible manner and is so divided in the mechanism that failure to act is impossible. The lower pivoted armature releases the switch for "no current" and the upper armature for "overload." The adjustment of one does not in any way affect the other.

Fig. 2 illustrates the "Card" automatic safety and limit switch designed for use with motors not provided with a safety switch, thereby saving the user the cost of a new rheostat. This is done by simply changing the connection of wires between the starting box and motor, to the switch, and operates in every way the same as the "Card" combined switch and rheostat, illustrated in Fig. 1.

When the current for any cause ceases to flow, the switch will automatically open, and also if the motor is overloaded more than is provided for in the adjustment of the spring holding the upper armature off the magnets. Where old style starting boxes are used, it is necessary to look after an overload and this is usually done by inserting in the circuit near the motor, pieces of fusible metal, supposed to have a certain carrying capacity at

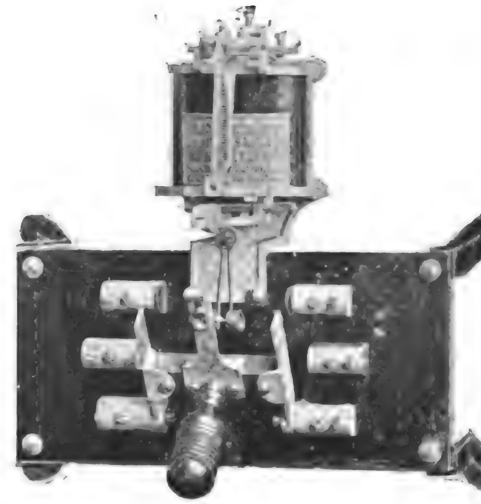


Fig 2.—Card Automatic Safety Limit Switch.

which they will melt, thereby opening the circuit. The result in most cases is, if the fuse is just suited to the motor and a temporary overload happens a few times, blowing it, the trouble of putting in a new one will tempt the attendant to put in one of twice the carrying capacity necessary, or, as is often the case, a piece of wire or other metal, so that the motor has no protection at all. Again, fuse metals are never reliable, since it is hard to get two pieces that will melt at the same temperature, and if they do, the time taken to fuse them may, with a heavy current, affect the armature seriously. By using the "Card" switch there is no danger whatever of injury to the armature because of overloads, since it can be depended upon to act every time and act promptly.

The "Card" automatic starting boxes will perform the following duties: First: They will prevent excessive overload on the motor at starting, caused by cutting out the resistance too fast. Second: They will open the motor circuit and cut in the resistance instantly, if the generator stops or the line is opened. Third: They will open the circuit and cut in the resistance if a load is put on the motor in excess of the limit for which the regulating spring is set. Fourth: They will open the circuit and cut in the resistance if the belt breaks or is thrown off. Fifth: They will prevent the starting of the motor in any but a safe and proper manner, and will take care of it while running, better than any attendant can, and act much quicker.

ELECTRIC POWER AT THE NEW CARNEGIE STEEL WORKS DUQUESNE, PA.

The Carnegie Company will shortly erect six blast furnaces close to their steel works at Duquesne, Pa., upon 100 acres of ground about four miles from their Homestead Works. The furnaces will be the largest ever built and the whole plant equipped with the best apparatus in such a manner that most of the work will be done automatically by electric and steam power. When completed, the electric power station will generate about 3,000 H. P. for light and power. There will be about 30 very powerful electric cranes, 3 or more electric travelling bridges over 250 feet span, the largest ever built for unloading ore, about 15 electric motor cars, half a dozen electric conveyors and a large number of stationary motors for driving miscellaneous apparatus.

There will not be a single belt in the whole power station, as the generators will be direct connected to the steam engines, and the arc machines direct connected to the electric motors that will drive them.

In all the Carnegie Works, electricity is used as much as possible and with great success, especially at their Homestead Steel Works and their works at Bessemer. In Homestead alone are running electric motors aggregating 4,000 H. P., and in Bessemer about 2,000 H. P. The electrical work will be installed under the supervision of Mr. Eugene Friedlaender, electrician to the Carnegie Company.

THE GIRARD WATER WHEELS FOR LIGHTING AND POWER.

These wheels were invented and developed in Europe, where they are very largely in use, being applied in nearly all cases where the head is high, and in many cases of low but steady pressure. They are made with vertical or horizontal shafts, full or part admission, and have ventilated buckets which are not filled with the water. They are impulse, as distinguished from pressure wheels, which allows them to be governed economically and satisfactorily.

The engraving, Fig. 1, shows a Girard water wheel built by the Girard Water Wheel Co., of San Francisco, Cal., made to couple to the arbor of a 60" circular saw mill. Part of the coupling is shown on the end of the shaft, and the other half is movable, so that the wheel can be disconnected from the saw and used to pull logs into the mill, or both operations can proceed at the same time. The small pulley on the wheel shaft has a belt running a counter shaft which operates the log turner and jack. The wheel is cast in brass to withstand the shocks consequent upon the method of operation. The diameter is larger than would otherwise be necessary in order to give the correct speed, 600 revolutions per minute, to the saw. A hand regulator is attached, the operator controlling the supply of water as the work increases or decreases. The head in this case is 350 feet and the wheel is made to develop 50 H. P. The bearings are large and are made self-oiling. The I-beam base is used on account of lightness and strength, a desirable combination where transportation is difficult. The wheel was boxed in after being set in place, which method is the usual one in many localities.

Fig. 2 shows a combination of a Girard water motor and 100-light dynamo, mounted on the same base, and connected by a flexible, insulating coupling. The water motor is 16½" in diameter, with simple contracting nozzle of sufficient size to develop the power required by a 100-light dynamo. The head is 750 feet and the speed 1,400 revolutions per minute.

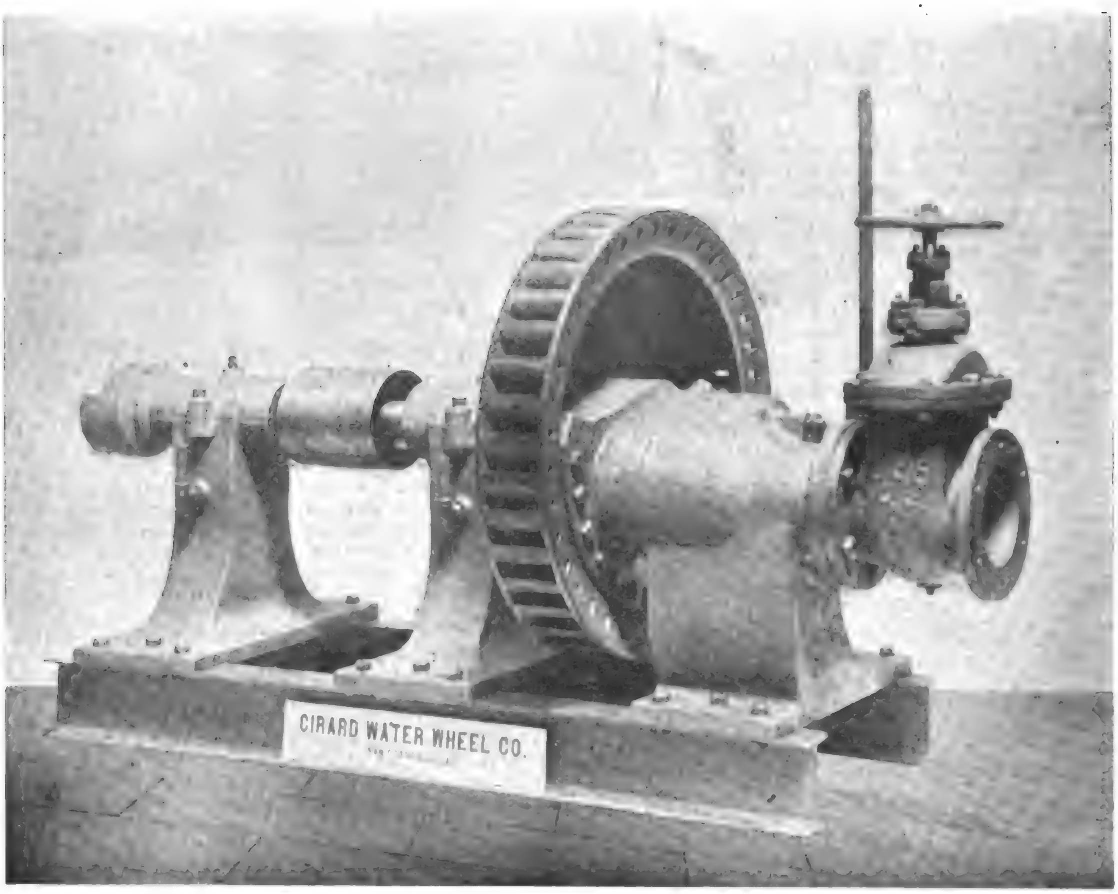
The "S. & V." inertia governor is partially shown inside of the pulley which acts as a covering for it. The indications of the governor are transferred through levers to the balanced valve, which controls the admission of water to the hydraulic cylinder operating the nozzle. The construction of the governor is such that there can be no variation between the work of the dynamo and the power on the motor without a change in the cylinder, and the connections are so close and the movements so rapid that the nozzle area is altered immediately after the change takes place and before the inertia of the moving parts allows the speed to vary. The water to supply the cylinder is taken from the upper side of the gate, and is passed through a self-cleaning strainer to remove obstructions.

The dynamo is of the multipolar, type D, with large self-oiling bearings, which is the type the Electrical Engineering Company of San Francisco, Cal., has been making for the past six or eight months. It is a simple shunt wound machine, in which the drop in potential is compensated for by an increase in the speed of the water wheel. The construction of the governor is such that this can be done by adjusting the weights.

There is a wide difference between the control of steam and water power. Steam, being elastic, can be throttled without much loss, as it expands and performs work in proportion, but throttling water means a direct and serious loss. The introduction of a butterfly valve or other obstruction in the supply pipe, does regulate speed to some extent, but it is only by reducing the available pressure. The loss is two-fold: by reason of the decreased pressure, and the fact that the proper relation between the spouting velocity of the water and the speed of the wheel is not preserved.

These facts lead to the conclusion that while throttling may operate well in steam engines, it is not allowable in water power development. The best regulation is effected by control of the size of the issuing stream, and this must be done by a quick acting but not over sensitive governor. What is needed is a governor which goes into service on a slight change of load, and not one which depends on a change of speed. Centrifugal or ball governors have been tried in all forms and applied to all kinds of intermediate mechanism; they have been used to direct the power obtained from the wheel through a belt, to control valves operating hydraulic cylinders, and to control a ratchet and pawl. None of these has given satisfaction and they are being abandoned very rapidly; in many cases "man regulation," for want of something better, superseding them.

The difficulty lies in the fact that there are too many steps in the mechanism: first, change of speed; second, vertical movement of the balls; third, operation of the governing power, and then time is required for the effect to reach the wheel and alter its speed. All this may *correct* a fault, but it cannot *prevent* it. The Girard Water Wheel Company has been giving especial



THE GIRARD WATER WHEEL FOR LIGHTING AND POWER.

attention to this subject of water wheel regulation, and it has perfected and put into practical use, what has been regarded heretofore as impracticable, viz, an efficient contracting nozzle, operated by a quick-acting and reliable governor.

The latter is so constructed that the entire load passes through it, and by means of a simple arrangement of springs and weights this load is weighed, just as it would be on a pair of scales, and *changes of load* are instantly indicated by the scales. It is not necessary to have a change of speed to set the governor in operation, and on this fact rests the secret of its success.

To render it very sensitive the governor is made to do no more work than is required to move a well-fitted and balanced valve, which connects, through large ports, to a hydraulic cylinder, where water under pressure is kept ready to open or close the nozzle. These connections are so close that the nozzle changes before the speed of the wheel can alter. The Girard wheel can be regulated to any extent for varying quantities of water. This is of great advantage in localities where the supply varies during the year. There is no change in any of the mechanism to accomplish this result, for as the supply decreases the work done by the wheel is decreased, and the governor automatically closes the nozzle. Thus it may be seen that it is only necessary to keep the work to be done within the limits fixed by the quantity of water.

The construction of these wheels allows a very large volume of water to be applied, while they are well adapted to small quantities, rendering them equally efficient under very high and very low heads. Owing to their practical advantages in these respects they are very largely used on the Continent of Europe, and have, to a great extent, superseded all other kinds. The ability to use large volumes of water makes it possible to employ wheels of comparatively small diameter, and renders possible, in many cases, direct connection between the wheel and the machine to be driven, thus avoiding the use of belts and countershafts.

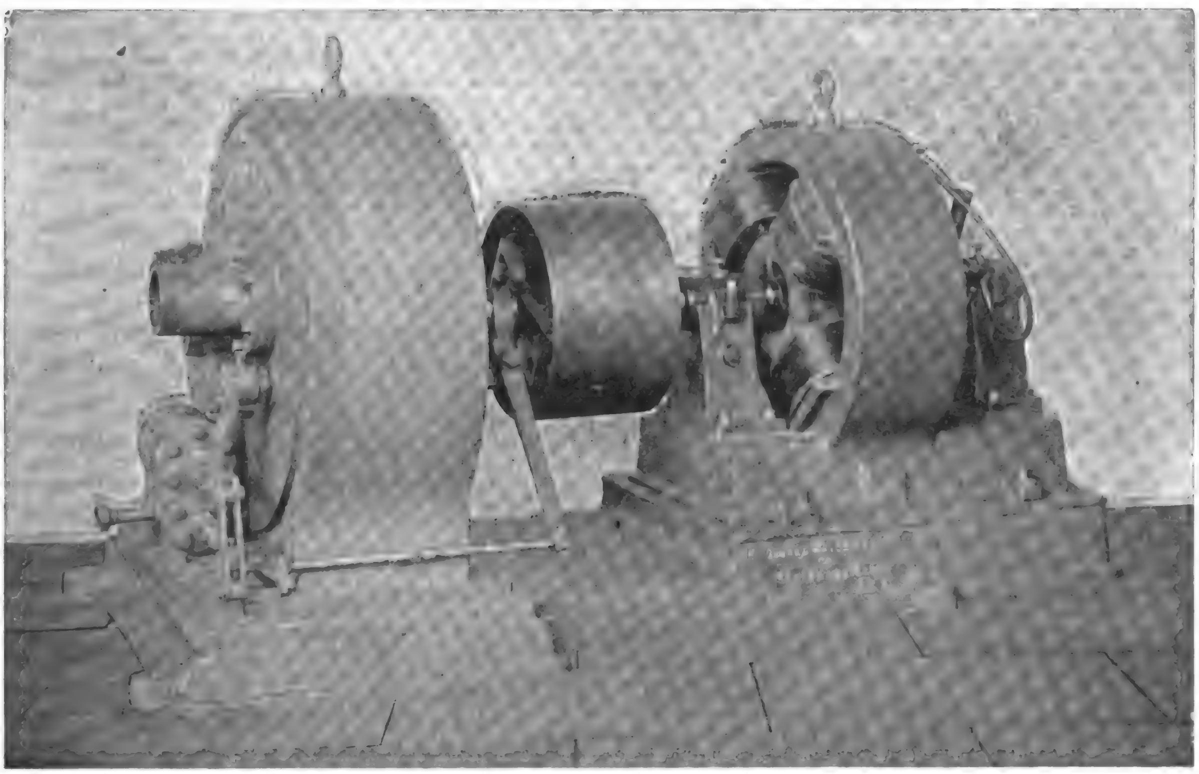


FIG. 2.—GIRARD WATER WHEEL DIRECT CONNECTED TO MULTIPOLAR GENERATOR.

NIAGARA ELECTRIC POWER.

The Schellkopf Hydraulic Power & Manufacturing Company has let the contract to the John Leffel Company of Springfield, O., for three water wheels of 1650 horse-power each. The wheels will be used for the new electric power station of the company at the lower river bank near the Cliff Paper Mills.

EGYPT. The General Electric Co. is reported to be anxious and willing to carry out the electric power scheme which contemplates the utilization of the flow of Nile water at Fayoum, for the distribution of power and for an extensive trolley system.

REFUSAL OF BUFFALO FRANCHISE BY THE NIAGARA FALLS POWER COMPANY.

The following important communication has been addressed by Mr. W. B. Rankine, of the Niagara Falls Power Co. to Chairman Boeckel of the Buffalo Council Committee, under date of August 31:

The Niagara Falls Power Company having been asked to signify its views in regard to the proposed franchise recommended by the joint Committee of the Board of Councilmen and Aldermen, of which a copy was received on the 8th inst., I regret to reply that in the form proposed the franchise is unacceptable to the company, principally for the following reasons:

First—The second clause is objectionable as it requires the company not only to construct, but also to maintain during the life of the franchise, poles and conduits furnishing accommodation sufficient for at least two other companies, with requirements equal to its own. That is, while in ordinary course the power company would provide a line or conduit only twice the size required for its own first uses, it would under the proposed franchise, have to provide and maintain accommodations six times as large as required for its own special use.

The company will be willing to accept the provision requiring it to erect poles of a capacity sufficient for one other company and for the city's free use and to lay for its mains (though not for its lateral lines) conduits with a capacity sufficient for the city's free use and for the use of one other company requiring as great facilities and making use thereof within five years from construction, upon payment of a proportionate part of the cost thereof, including interest, the Niagara Falls Power Company to have the sole right of use of any line not so used and paid for within the stated period of five years; it being understood that similar conditions in favor of the Niagara Falls Power Company would be annexed to any such grant to any other company.

Second—The sixth clause is also objectionable as it requires that all wires strung under the grant shall be placed underground, and the poles shall be removed within such reasonable time as the Board of Public Works, with the approval of the Common Council, may require.

The requirement in this form would prohibit the construction of any lines, for they might be ordered down immediately after erection. The company thinks that all rights would be sufficiently protected by a condition that it should remove any such line on one year's notice.

Third—The ninth clause is objectionable in that it dates from the acceptance of the franchise an annual tax of 5 per cent. upon the gross receipts of the company. The probable cost of the first installation and of the successful introduction of power in Buffalo is so great that the company would be unable to accept such a

provision or tax upon its gross receipts, or any provision for a tax of lesser percentage upon such receipts unless either (1) the tax be remitted for the first five years of the franchise, or (2) the tax be limited to all power delivered after the first 10,000 horse-power. The modification of this clause involves a corresponding modification of the 12th clause.

Fourth—The 11th clause, limiting the grant to a period of 25 years, is impossible of acceptance, for the reasons distinctly set forth in the company's statement of February last. No franchise could be accepted for a period less than 36 years—the term of the company's bond.

Fifth—The 14th clause, reserving to the Board of Public Works or to the Common Council, the right to revoke and annul the grant on 10 days' notice for any alleged violation or failure to comply with any of its provisions, would forbid the investment of capital upon a franchise containing such a provision, and is therefore unacceptable.

Some phrases in other clauses of the franchise call for modification, which, however, do not need consideration until after the objections, above recited, are obviated.

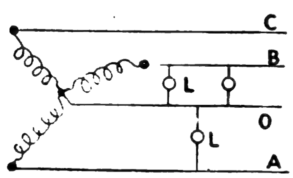
OERLIKON THREE-PHASE METHODS.

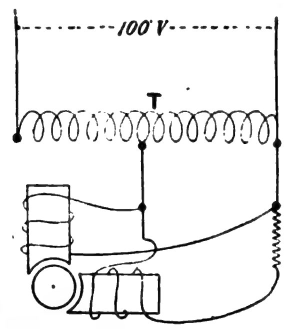
As the result of an interview with Mr. Emil Kolben, chief electrician of the Oerlikon Co., Switzerland, a correspondent of the London *Electrical Engineer* describes the following methods used by that company in its three-phase work.

The company use the three-phase alternating system for large transmission work if the main demand is for power, as with this the cost of the line is a minimum. If lighting is required on the same system, they sometimes use the star winding and run a neutral wire O from a common junction. They then place the lamps between any one of the three wires and the neutral wire, and in this way the fluctuation of voltage when the branches are unequally loaded is to a large extent prevented. (Fig. 1).

To avoid the rush of current at starting, the method devised by Mr. Kolben is as follows:

Instead of using the full voltage when starting the motors, he employs a transformer T in connection with the switch, so that the energy required to start a motor is attained at a low voltage by transformation (Fig. 2). In this way the actual current taken





FIGS. 1 AND 2.—OERLIKON THREE PHASE AND ARC PHASE WIRING.

from the main in starting is always less than the normal working current of the motor, and with moderate sized motors is often less than half. The Oerlikon Co. also supply their motors with a fast and loose pulley arrangement, so that they are started free, or without load, and a frictional clutch introduces the load gradually when the motor has attained its speed.

POWER TRANSMISSION AT BUTTE CITY, MONT.

Two gentlemen who are known to be experts for L. L. Nunn, president of the San Miguel Consolidated Gold Mining Company of Colorado, arrived in the city yesterday. They are not very communicative as to the nature of their business, but from other sources it is learned that Mr. Nunn is interested in the transmission of electrical power over long distances, and has done considerable in that line. His company has a power house at Ames, Colo., in which the Westinghouse Company placed the largest dynamo in the world (*sic*). From that house power is transmitted over lofty peaks as high as 14,000 feet above sea level, to a number of mines, some being 30 miles distant.

It is understood that this gentleman, who is backed by great capital, has decided to look over the field in this city with a view to erecting a similar plant in this locality and supplying the mines and mills with electrical power. The two experts mentioned are here for the purpose of investigating the available water powers in this locality. One of them is quoted as having said, he believed it possible to transmit power to this city from Great Falls.—*Butte City Miner.*

LETTERS TO THE EDITOR.

THE HORSE POWER OF A LIGHTNING STROKE.

IN THE ELECTRICAL ENGINEER of Aug. 28 under the above heading appears an item from the *Archiv für Post und Telegraphie* according to which Messrs. Siemens & Halske, of Berlin, estimated a lightning stroke at 70,000 H. P. Is it not possible that the nails in this case were fused by the heat of the flash or arc itself instead of the resistance of the metal?

In the above I have spoken of the lightning discharge as an arc and practically I fail to see the difference between that and the arc of the electric lamps except as one of degree. Now we know that an arc of considerably less than 1 H. P. will fuse metals very rapidly.

A lightning flash on entering and leaving a good conductor attached to a poor one will fuse both ends of the good conductor. This conclusion seems to me—at the risk of differing with Messrs. Siemens and Halske—to be the only proper one. A current of 200 amperes at 2,000,000 volts would, I should think, have reduced that post to charcoal and ashes. This conclusion is further supported by the fact that in sections of this country where lightning is no plaything a No. 8 iron wire is considered amply sufficient to safely carry off all discharges from telegraph lines and offices.

I do not wish to underestimate the power of the lightning discharge, for were it not that its power is nearly all exerted in overcoming the resistance of the air, its effect on terrestrial objects would be fearful to contemplate; but I wish to point out that the experiment above referred to is not conclusive and that the same charge would probably not fuse or heat seriously a well grounded iron wire even as small as No. 14 B. W. G.; while in jumping from a sheet iron cornice to an iron beam both would probably show fused spots. Possibly Siemens and Halske took all this into consideration but the clipping referred to does not indicate it.

A. E. DOBBS.

BROOKLYN, N. Y.

THE SUCCESS OF THE B. & O. ELECTRIC LOCOMOTIVE.

I notice in your issue of Sept. 11th a quotation from a Mr. S. B. Caswell, of Indianapolis, making some astonishing and perfectly unwarranted statements about the Baltimore locomotives.

I have never heard of Mr. Caswell, and, therefore, cannot say how well qualified he is to pass judgment upon such an important subject. I can say positively, however, that so far as known to the engineers in charge of the work, and the railway officials having to do with the locomotive, there is nothing to complain of.

Since formally starting to operate, about a month ago, the locomotive has been in continuous service and has handled all the freight trains. Facilities for handling passenger trains have not yet been completed. There have been no mishaps of any kind, and we have been astonished at the remarkable freedom from trouble, considering the many novel features involved. The trainmen have only words of praise for the easy and gradual manner in which the locomotive handles the trains, the statement coming unsolicited from them that there are no such shocks as would be experienced with steam locomotives. There is, of course, nothing surprising in this as the amount of power can be regulated to a nicety and there are no dead points.

The overhead trolley system has been peculiarly successful; it gives absolutely no trouble. The trolley carries as high as 4,000 amperes, and has been run at a speed of 60 miles an hour. The trolley line was required to fill the most peculiar conditions. In the tunnel it had to be between the tracks and low down; out of the tunnel it had to be high up and immediately over the tracks. The trolley follows these irregularities without experiencing any difficulty, and passes through frogs and switches without having the slightest attention paid to it, all the while carrying a current exceeding the total output of many electric railways. Trains weighing 1,400 tons have been handled up an .8 per cent grade with perfect ease.

The locomotive seems to leave little room for improvement and will undoubtedly continue for many years in its present shape to perform the service for which it was designed.

When after years of heavy labor a great work has been completed to the satisfaction of all interested parties, and a new and promising field has been successfully opened up that will benefit all, it must be a peculiar motive indeed that will induce one to go out of his way to impair and belittle that work without having the facts to support his assertions.

W. H. KNIGHT,
Engineer, Railway Dept., General Electric Co.

SCHENECTADY, N. Y., Sept. 12.

MR. L. B. VAN NUYS, of Peoria, Ill., writes: "Your Data Sheets are a great convenience, and one that is greatly appreciated. They are bound to be a success."

MISCELLANEOUS.

ELECTRIC FURNACES AND THEIR APPLICATION TO THE TRANSFORMATION OF CARBON INTO GRAPHITE.[1]—II.

BY CH. STREET.

In 1886 Messrs. Cowles patented a furnace (Fig. 5) in which the material to be treated was packed around two carbon electrodes, in close proximity at first, but gradually separated as the electric resistance of the furnace fell. At the start the electrodes were 25 mm. apart; at the end of the operation they were 1.2 metres apart. This pattern of furnace shows considerable similarity to that which later on was made use of by Mr. Acheson for the production of carborundum, with the difference that the carbons in

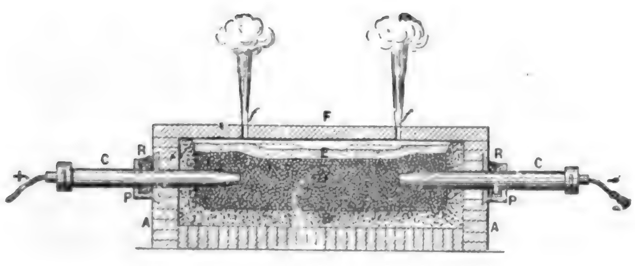


FIG. 5.

the latter furnace were maintained permanently in contact. The difficulties encountered by Messrs. Cowles in following the progress of the process going on inside their furnace, and estimating the separation to give to their electrodes, led them in the same year (1886) to take out a patent in which they claimed the simultaneous use of an ammeter and a resistance interposed in the circuit of an electric furnace with a view to the control of the process (Fig. 6).

In 1886 Messrs. Rogerson-Statter and Stevenson took out a

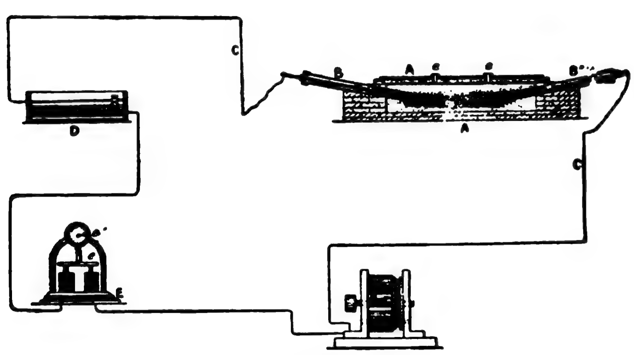


FIG. 6.

patent, the object of which was the utilization of electromagnetic attraction and repulsion to control the path of the electric arc when employed to produce the heat of a furnace. There is often an advantage in keeping the arc in a fixed position, either at a distance from or close to the material to be heated. In this patent the desired attraction or repulsion was produced by means of a permanent magnet, an electromagnet, or a solenoid. One of the arrangements employed is shown in Fig. 7. A is the body of the

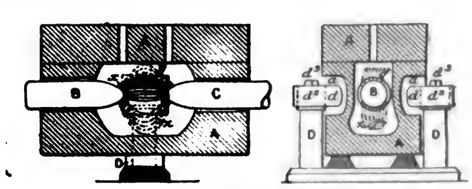


FIG. 7.

furnace, B and C are the two electrodes. On either side of the furnace are the two poles D of the electromagnet. The polar expansions are movable in order to permit of the air-gap being varied. The effect of the electromagnet is to deflect the arc towards the top or bottom of the furnace, according to the direction of the current circulating around the electromagnet coils.

In 1887, MM. Bernard Frères patented the furnace shown in Fig. 8. Inside the furnace there was a carbon crucible, C, containing the substance to be treated. This crucible was inside a second crucible, C', made of refractory material, and resting on a carbon support, p, connected to the positive pole of the source of electricity. The carbon electrode a was connected to the negative pole. The crucibles C and C' were first heated by fuel burnt on the bars G, and when the charge had attained a suitable temperature the heating was completed by an electric current, which at the same time electrolyzed the substance contained in the crucible.

In 1887, M. Héroult patented a furnace intended for the production of aluminum. The crucible a (Fig. 9) contained the bath

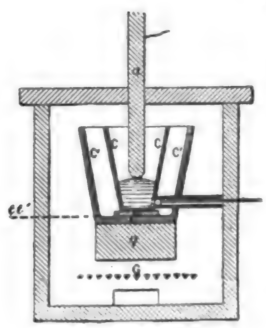


FIG. 8.

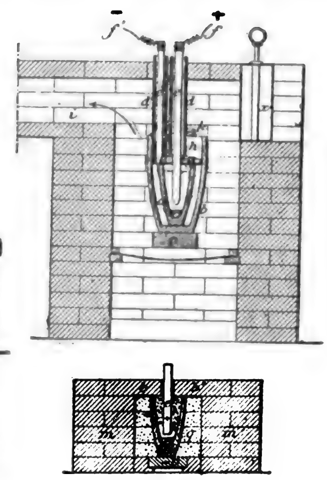


FIG. 9.

of cryolite (double fluoride of aluminum and sodium). This crucible was placed in a second crucible, b, made of graphite or plumbago, and resting on stand c, which was interposed between it and the fire bars. The electrodes e and e' were of carbon. The anode was placed in the axis of the crucible, and the cathode was formed by the crucible itself, which was closed by the lid g.

In 1887, Messrs. Cowles took out a patent, the subject of which was an electric furnace in which the charge was introduced in a continuous manner. The positive electrode A (Fig. 10) is formed

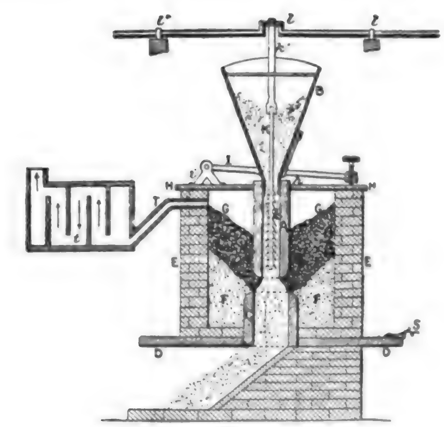


FIG. 10.

by a carbon tube. B is a feed-hopper, having its lower end fixed to the top of the electrode A. C is the negative tubular carbon electrode, fixed to the plate D arranged at the bottom of the furnace. The containing walls E are of refractory and silica bricks. A packing F of charcoal, or of lime and retort carbon mixed, surrounds the negative electrode C, and insulates it electrically and thermally. A packing, G, similar to the above, surrounds the zone of fusion between the two electrodes. The grain of this packing is, however, coarser, in order to allow the gases which result from the reactions of the furnace to escape by the tube T which leads them to the condenser t. The upper part of the furnace is closed by the plate H, provided with an aperture h, though which the positive electrode slides freely. An arm I, pivoted at i, enables the electrode A to be raised or lowered by means of a screw, in order to increase or diminish the zone of fusion or compensate for the consumption of the electrodes.

"I am placing my copies in the college reading room where they will be extensively read by our students. The more I see of the paper the more I value it." Thus Mr. Alonzo Collin, of Cornell College, Mount Vernon, Iowa.

TELEPHONY.

BRITISH vs. CONTINENTAL TELEPHONY.

Replying to the article in the London *Electrician* by Mr. G. L. Addenbrooke, printed in our issue of Sept. 4, Mr. A. R. Bennett writes as follows to our contemporary: I was pleased to notice that Mr. G. L. Addenbrooke, has, with the help of figures taken from my recently-published book on "Continental Telephony," pointed out, in a manner which you, in your leader, justly commend, that one of the most persistently-advanced excuses for high telephone subscriptions in this country is devoid of foundation. For many years the shareholders of the National Telephone Company, Parliamentary Committees and the general public have been told that one of the chief causes of high rates is the much greater cost of labor of all kinds in this country. That this is not the case was one of the facts my book was designed to prove, and Mr. Addenbrooke has very neatly clinched the demonstration.

While admitting as much in your leader, you say "it is for him or others to prove that the cost of erecting, maintaining and working a telephone system is in the same state, that the Continental concerns honestly pay their way and something over." Now the lowest rates on the Continent are nearly invariably granted by companies who issue detailed and clear accounts at regular intervals; and had Mr. Addenbrooke dipped deeper into my book when reviewing it, he would have found that particular care had been taken to prove the very thing that you infer still calls for proof. Translations of the recent accounts and balance-sheets of several Continental companies are given in full, and these show conclusively that dividends even better than those habitually paid by the National Telephone Company are earned year after year on subscriptions which the Directors of the National Telephone Company have on numberless occasions stated to be ridiculous and unworthy of serious notice; and this after providing (which the National Telephone Company has never done) sickness and accident funds for the benefit of the male and female employees, and after putting aside adequate provision for deterioration and renewals. These accounts show that low subscriptions pay handsomely in exchanges larger than any possessed by the National Telephone Company, as well as in medium-sized and small towns. It is fortunate that these companies' accounts exist, since the various States adopt methods which render it impossible for an outsider to tell whether their systems are remunerative or the reverse.

If Mr. Addenbrooke cares to search even deeper within the book, he will find several other pet illusions and excuses effectually disposed of.

GROWTH OF THE ERIE TELEPHONE CO.

A recent feature of the Boston market has been the advance in Erie Telephone to above sixty-four. "I am not surprised at the advance in Erie," says Treasurer Glidden. "Erie never has sold quite up to its value. Our total indebtedness is less than $1,000,000 which was caused by our real estate, underground, and long distance investments.

"We own two buildings in Cleveland which will cost completed over $200,000. One in Galveston costing $50,000, one in San Antonio costing $20,000. All our wires are underground within two miles radii of our larger exchanges, fully 5,000 miles, and we have at least 5,000 miles of metallic long distance lines. Originally we built four wires between the principal cities in Texas, our longest line being from Clarksville to Galveston, 560 miles. Between many points we have been obliged to duplicate the entire system on account of the large increase of business.

"The Erie Co. is the third largest of the Bell sub-companies, the Central Union of Illinois and Indiana being the largest with about 26,000 subscribers, the New England Telephone & Telegraph Co. second with 23,000 subscribers and the Erie third with 17,000 subscribers.

"The Erie is earning 6 per cent. and can easily pay 5 per cent. dividends, but I am not in favor of an increase at present although it is only a matter of a short time when an increase will be quite certain."

THE HARRISON SYSTEM IN INDIANA.

A special dispatch from Anderson, Ind., of Sept. 7 says:—"The Harrison Telephone Company, which entered the field as a most formidable opponent of the Bell syndicate, to-day officially abandoned the Anderson field, as they have also abandoned Richmond, Ft. Wayne, Terre Haute and other fields. They had a franchise in each of these places, and at the time it looked very much as if they would dislodge the Bell system, as they did at Lafayette. They promised a very low rate, and the Bell thought them formidable enough to lower their rates in this city to $6 and $8 on the year. The people of Anderson want a rival company and will give a franchise to a responsible party, as they did the Harrison." The Harrison Telephone Co. says that the statements in this dispatch are unfounded and untrue and that it is as active as ever in putting in new exchanges.

EXCHANGE TRADING BY TELEPHONE IN CHICAGO.

There is a prospect that business on the Chicago Board of Trade will, in the near future, be conducted by means of telephones. Twelve brokers have been trying the experiment of sending their orders to their representatives in the pits by telephone instead of by the sluggish messenger boy. In this there will be the advantage of a gain in time, and the chances of any other broker finding out what is being done will be greatly lowered. The telephones have been put in at the northwest corner of the floor, and each talker is inclosed in a metal frame so that his neighbor can neither hear nor see what he is doing. There will be no bells, but there will be colored lights similar to the express telephones. The office calls up by simply taking the receiver from the telephone. A light flashes on the floor of the exchange, and a much larger colored light will show the numbers much higher up on the wall, so that the dealer in the pit can see the number and rush for the telephone. It is thought by this means at least five minutes will be gained.

IN ITALIAN NUNNERIES.

Telephones are to be admitted into Italian nunneries by a recent decision of the Congregation of Bishops, but a strict censorship will be exercised over the wires.

BELL TELEPHONE OUTPUT.

The American Bell Telephone Company's instrument statement for the month ending Aug. 20 shows: Gross output 11,009, increase 5,320; net output 2,279, against a deficit last year, increase 3,121. Since Dec. 20, gross output 109,905, increase 56,761; net output 54,054, increase 47,890. The total number of instruments outstanding is 636,560, an increase of 63,905.

HANDLING A PARADE BY TELEPHONE IN BOSTON.

In summing up the results and effects of the recent visit of 40,000 Knight Templars to Boston, the papers lay stress on the utility of the telephone. The New England Telegraph and Telephone Co. furnished eight pole stations with operators. At each pole also was a member of the staff of the Grand Marshal; and in this way the vast body of men was kept well in hand by a single wire and eight telephones.

TELEPHONE NOTES.

LUCAS, O.—The People's Telephone Company has extended its line to Lucas.

AMHERST, MASS.—Workmen have begun putting up the wire for the telephone exchange.

PUTNAM, N. Y.—A telephone line is being erected between Putnam Station and Benson.

MUSCATINE, IA.—A movement is on foot in this city for the organization of a new telephone company.

BELLEFONTAINE, O.—The telephone company have just finished putting in the telephones, and now about 75 business houses in this city are connected.

FLAGSTAFF, ARIZ.—Thirty-five subscribers have been secured for a telephone system here, and the line will be in within thirty days. The Sunset Company is putting in the system.

MERIDIAN, IDAHO.—The citizens of Meridian will soon enjoy the benefits of communication by telephone with Boise and other points. The line will be in operation by September 1.

MR. JOHN HAMER has become manager of the Phœnix Telephone Co. at Altoona, Pa., and his position as manager of the local Postal Telegraph office has been taken by Mr. A. P. H. Saul.

MILFORD, CONN.—Before many weeks Milford will have a telephone exchange on a par with any in the state, equipped with the best apparatus—long distance transmitters, metallic circuit, etc.

KANSAS CITY, MO.—Daniel A. Williams, who is interested in a new telephone, is preparing an ordinance granting a franchise in Kansas City which "will knock the pending franchise in cheapness of rates and inducements to the city."

KENSINGTON, PA.—A local telephone exchange is soon to be established at Kensington. Besides affording local communication, it is understood that connection will be made with Parnassus, Springdale, Tarentum and Natrona.

MADISON, WIS.—Gen. A. C. Parkinson and John Lamont of Madison have purchased the right to sell or manufacture the Standard telephone in the states of Washington, Oregon and California, and have gone west to engage in the business.

PERSONAL.

BLAKE & WILLIAMS.

E. R. Knowles.

WE take pleasure in announcing that the old and well known firm of Blake & Williams, engineers and contractors, of 362 & 364 West Broadway, New York, have, with their usual energy and desire to be fully abreast of the times, added to their other lines of engineering work, that of the installation and equipment of all kinds of electric plants. This concern, one of the oldest in the city, has always occupied a foremost position as steam heating, ventilating and power engineers and contractors. It is their intention to make their new branch, electrical equipment, as complete and as satisfactory in every way, as they have hitherto their other branches of engineering.

Mr. Francis A. Williams, the head of the firm since the death of Mr. George W. Blake, is a native of Brooklyn, and a man of practical skill and thorough experience and is conversant with every detail of his business, having served his time as an apprentice and worked his way up from that through every position in the company to that of head of the firm. He has associated with him as General Manager of the Electrical Department, Mr. Edward R. Knowles, E. E., C. E., Member of the American Institute of Electrical Engineers and late Chief Electrical Engineer of the Schuyler Electric Company of Middletown, Conn., and Mr. Francis Broadnax, E. E., M. E., late Chief Engineer, Incandescent Electric Light Installation, World's Columbian Exposition, Chicago.

F. A. Williams.

Mr. Knowles has been long and favorably known to the electrical fraternity, having done pioneer work in this branch of engineering as early as 1879 and having had since that time a large and varied experience in manufacturing, designing and exploiting a great variety of electrical apparatus.

Mr. Francis Broadnax is well known as an expert installation engineer; his best known work being the installation for the New York Insulated Wire Company of a complete incandescent electric light plant of 68,000 lights at the World's Columbian Exposition, Chicago. He is an expert in all branches of installation work and is well and favorably known to all connected with this branch of engineering.

F. Broadnax.

This branch of their work is now thoroughly organized and ready for business and Blake & Williams are prepared to furnish estimates on any and all kinds of electrical installation and contraction work and feel confident that they will be able to give as good satisfaction with their work in this line of engineering as they have hitherto done in their other branches. The inter-relation between electricity and the other branches of engineering practice, requires the existence of such firms as this.

MR. EUGENE FRIEDLAENDER, who has just been appointed electrician to the Carnegie Steel Co., at Duquesne, Pa., whose immense power and lighting plant is described elsewhere, is a native of Bromberg, Germany. After studying at the University of Berlin and at the Reichsanstalt at Charlottenburg, Mr. Friedlaender entered the employ of the Allgemeine-Elektricitäts-Gesellschaft, Berlin, where he remained for several years, acquiring an extended practical experience. In quest of larger opportunities he came to this country, his first engagement being with the Ries Electric Co., of Baltimore, which was followed by his engagement by Mr. Edison at his laboratory at Orange, N. J. Mr. Friedlaender subsequently accepted an offer from the Westinghouse Co., from which he resigned to accept the position he now holds.

MR. JAMES DORSEY, superintendent of the Northampton, Mass., Electric Light Co., has resigned his position and has gone into the electrical construction and supply business in the same city.

OBITUARY.

HENRY BENTLEY—"FATHER OF THE LOCAL TELEGRAPH SYSTEM."

The death is announced of Henry Bentley, at his summer residence near Rhinebeck, on the Hudson. He was born in Dutchess county, New York, in 1834. He early cultivated a taste for writing, by frequent contributions to the journals published near his home, and when he reached New York, at the age of 20, he became a writer for the *Tribune*, in addition to his labors as bookkeeper in a coffee and spice house.

He got into the electrical business, which occupied so much of his attention afterward, by becoming connected with J. B. Richards, a skilled mechanic, who was perfecting Royal E. House's printing telegraph instruments. Mr. Bentley assisted in organizing a company which was known as the New York City and Suburban Printing Telegraph Company, and of which he was made the general manager, this position including also the duties of constructor, repairer, batteryman and cashier. The company opened offices for the transmission of messages at a low rate, but did not succeed. Then Mr. Bentley proposed to the capitalists who were in the concern that they lease the lines to him for 25 per cent. of the proceeds, and they accepted. He opened offices in various hotels and other places and soon began to make money rapidly. He laid a cable to Brooklyn, which no one had successfully done, and thus added a large and profitable business to what he already had. The success of this enterprise, it is considered, made him the father of the local telegraph business.

Before the war, when there were no branch post-offices in New York city, Mr. Bentley opened an office on Madison Square to receive mail, which he had conveyed to the Post-office for one cent a piece. This business became very profitable and he sold it for a large sum. Soon afterward his health broke down and he disposed of his local telegraph interests. When he recovered he went to Philadelphia. He had meanwhile written much for New York newspapers, and when he removed to Philadelphia he was engaged on the editorial staff of the *Inquirer*, serving it as a war correspondent.

Shortly before the war he again took up local telegraphy and built several private lines, which were subsequently amalgamated under the management of the Philadelphia Local Telegraph Company, capitalized at $400,000, with Mr. Bentley as president. He organized a service for bankers and brokers, and a local news service, which was maintained for many years. A branch of the local service was organized under the name of the "Gold and Stock Reporting Telegraph Company." Of this company Mr. Bentley was also the president. He was identified with the management of many Western Union Telegraph Company's subordinate companies.

Mr. Bentley helped to organize the Bell Telephone Company of Philadelphia, and for eight years was its President. He was a friend of Thomas A. Edison in the early years of the great inventor's public career, and had many interesting and curious letters from him. He exhibited the phonograph in his private office soon after it was first put in working order.

Mr. Bentley was attracted by any new and meritorious invention, whether electrical or otherwise, and it was this disposition which made him learn to ride one of the first bicycles taken to Philadelphia, which was somewhat of an undertaking for a man of his physique and years. He was a member of the Photographic Society of Philadelphia. He leaves a wife and one son.

MR. HENRY METZGER.

The friends of the late Henry Metzger will be interested to learn that by his own wish his remains were cremated.

Inventors' Record.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED SEPT. 10, 1895.

Alarms and Signals:—

Electric Signaling Apparatus, G. E. Miller, Boston, Mass., 545,903. Filed Aug. 1, 1894.
A railway signal.

Electric Signaling, G. E. Miller, Stoneham, Mass., 545,904. Filed Sept. 6. 1894.
A railway cab signal. Consists in providing with each alternating current generator automatic means for testing the condition of the apparatus.

Electric Alarm Clock, W. Kist, Hoboken, N. J., 546,016. Filed Feb. 6, 1895.

Signal Box, N. H. Suren, New York, 546,036. Filed Aug. 22, 1893.
Similar to patent below.

Signal Box, N. H. Suren, New York, 546,037. Filed Jan. 25, 1894.
Cut-out signal for fire alarm signaling boxes which combines in a single device all the functions of the door-and-wheel movement switches.

Bell Buoy, J. A. Fairbanks, Cambridge, Mass., 546,125. Filed Apl. 15, 1895.
A circuit breaker on shore strikes the bell in accordance with the chart number of the buoy.

Signal Transmitter, W. H. Davis and H. C. Christy, Como, Colo., 546,226. Filed June 3, 1895.
Designed more particularly for use in connection with meteorological instruments—a weather vane, for example.

Automatic Electric Fire Alarm, C. D. Tisdale, Boston, Mass., 546,261, Filed Feb. 12, 1895.
A special form of mercury thermostat.

Automatic Electric Fire Alarm, C. D. Tisdale, Boston, Mass., 546,262. Filed Mch. 25, 1895.
Consists of a wire made of material that will fuse at the desired degree of heat, located and run around a room or building.

Conductors, Conduits and Insulators:—

Manufacture of Electric or Other Conduits, E. L. Ransome, Chicago, Ill., 545,976. Filed Nov 23, 1894.

Flexible Conductor and Inclosed Conduit Therefor, L. Dion, Natick, Mass., 546,005. Filed Feb. 20, 1895.
Relates to systems of electrical propulsion of railway-cars, and particularly that class in which the conducting mains are placed in closed subways or conduits.

Insulator, Conductor, and Conduit for Electrical Wires and Cables, W. R. Hitchcock, Cornwall, Can., 546,232. Filed Oct. 12, 1894.
Details relating to a railway conduit system.

Dynamos and Motors:—

Regulator for Alternating Current Dynamos, E. W. Rice, Jr., Lynn, Mass., 546,190. Filed March 16, 1888.
The combination in an alternating current machine, of a field magnet produced by two independent sources, one practically constant and the other variable, of a branch having practically no self-induction around the coil forming the variable source, and means for varying the resistance in said branch.

Miscellaneous:—

Electric Drill, C. S. Bradley, Avon, N. Y., 546,002. Filed Aug. 20, 1892.
Relates to electric drills operated by alternating currents, its object being to render the strokes of the drill slow compared to the rate of current alternation.

Base Ball Indicating Apparatus, F. M. Chapman, J. W. Jefferson and T. Jefferson, New York, 546,008. Filed May 23, 1895.
For description see The Electrical Engineer, Aug. 7, 1895, p. 145.

Combined Puzzle and Toy, F. J. Mantel, Syracuse, N. Y., 546,171. Filed Feb. 8, 1895.
A magnet enclosed in a case operates a miniature figure on top of the case.

Art of Manufacturing Electromagnets, H. P. Brown, New York, 546,220. Filed Jan. 26, 1893.
A method for winding magnets with flat tape, and for insulating the same.

Electric Igniter for Gas Engines, F. S. Mead, Montreal, Can., 546,238. Filed Feb. 26, 1895.

Railways and Appliances:—

Rail Bond, R. A. Baldwin, So. Norwalk, Conn., 545,869. Filed Jan. 24, 1895.
Consists of two plug supports attached to the rails by screw threads, with a connecting conductor consisting of a stiff rod or wire threaded at both ends into the respective plugs.

Electric Railway Switch, R. A. Baldwin, So. Norwalk, Conn., 545,870. Filed Jan. 4, 1895.

Electric Railway, W. M. Schlesinger, Philadelphia, Pa., 546,059. Filed Nov. 24, 1885.
In an electric railway the combination of a series of separate feeding conductors extending in multiple arc relation from one generator pole or terminal to points along the line of way, safety devices for said separate feeding conductors a working conductor comprising a series of insulated or disconnected sections disposed along the line of way and supplied by said separate feeding conductors, and return circuit connections opposed to said sections and leading to the other generator pole, or terminal.

Speed Regulator for Electric Cars, I. D. Aiken, New York, 546,062. Filed May 4, 1895.
The object is to restrain the velocity of such cars within prescribed limits.

Electric Brake, W. Koedding, St. Louis, Mo, 546,120. Filed June 13, 1894.
Embodies a provision for using the brake, with air-power.

Closed Conduit Electric Railway, J. M. Deal, Fernwood, Pa., 546,130. Filed Nov. 26, 1894.
The combination, with a car, and an electric motor thereon, of a magnetic trolley arm directly connected with the pole-piece of the motor, and electrical connections between said arm and the motor.

Electric Railway System, H. A. Fry, Portland, Ore., 546,143. Filed June 13, 1894.
Details of construction.

Electric Locomotive, E. W. Rice, Jr., Schenectady, N. Y., 546,191. Filed Mch. 16, 1895.
The combination in a self contained electric locomotive, of a prime mover, direct current generator and separately excited rotary transformer, with alternating motors mounted on or geared to the axles of the said locomotive, and means for varying the periodicity of the current supplied to the motors from the rotary transformer.

Electric Brake, W. B. Potter, Schenectady, N. Y., 546,247. Filed Jan. 19, 1895.
An electric brake mechanism, a controlling switch for the electric motors, a brake switch, a reversing switch, and means adapted to prevent a simultaneous operation of any two of the switches.

Switches, Cut Outs, etc.:—

Cut Out Actuating Mechanism for Gas or Electric Light Systems, F. W. Cotton, Dedham, Mass., 546,090. Filed Nov. 12, 1894.

Automatic Electrical Cut-Out, C. C. Kritzer, Grand Rapids, Mich., 546,282. Filed Oct. 31, 1894.
Details of construction of an automatic cut-out for high voltage circuits.

Telegraphs:—

Tubular Pole for Telegraph or other Purposes, R. Mannesmann, New York, 545,901. Filed Feb. 9, 1895.

Telegraph-Receiver, O. P. Briggs & W. R. Patterson, Chicago, Ill., 545,986. Filed Oct. 11, 1893.
A receiver which will perforate paper tape to correspond with the telegraphic signals, and in which the punch and die used in perforating the paper may be operated by a single mechanism.

Telephones:—

Telephone Exchange Apparatus, A. Stromberg. A. Carlson and H. L. Knight, Chicago, Ill., 545,921. Filed Feb. 28, 1895.
The individual annunciators are wound to serve as clearing out annunciators.

Telephone Apparatus, A. Stromberg and A. Carlson, Chicago, Ill., 545,922. Filed March 29, 1895.
An improved form of granular carbon transmitter and switch.

Telephone, E. C. Parker, London, Eng., 546,027. Filed Feb. 14, 1895.
The combination with the vibrating diaphragm of a rotatable carbon holder carried in bearings thereon, and carbon in said holder.

Society and Club Notes.

OLD TIME TELEGRAPHERS CONVENTION IN NEW YORK.

The Old Time Telegraphers and the U. S. Military Telegraph Corps held their fifteenth reunion at the Broadway Central Hotel, this city, on Sept. 11, 12 and 13, and the occasion proved to be one of great pleasure to all concerned. The attendance was naturally large, and though the ranks of the pioneer Old Timers were evidently thinning out, the new Old Timers mustered in sufficient numbers to show that the succession has been thoroughly provided for.

The entertainments included a musical evening at Chickering Hall, a trip to Long Branch, and visits to the most famous sights and institutions in New York.

The new officers of the Old Timers are: S. A. Duncan of Pittsburgh, president; J. D. Flynn, vice-president; W. J. Dealy, secretary and treasurer; Robert Pitcairn, J. Campbell, M. W. Mead, S. P. Peabody and L. A. Somers, executive committee.

The U. S. Military Telegraph Corps re-elected its old officers, as follows: W. R. Plum, President; W. B. Wilson, vice-president; J. E. Pettit, secretary and treasurer.

The next meeting of the twin societies will be held at Pittsburgh, the second week in September, 1896.

BROOKLYN ELECTRICAL SOCIETY.

The Brooklyn Electrical Society held is third annual election of officers on Tuesday evening, Sept. 3, in the Society's laboratory and reading rooms, 370 Pearl street, Brooklyn.

The society will introduce a new feature during the coming season in the form of regularly conducted electrical experiments by selected members; also a carefully arranged programme of lectures on the latest novelties and inventions in the electrical field. Membership is open to all interested in the electrical science, and communications on the subject should be addressed to Arthur A. Fisk, corresponding secretary, 370 Pearl street. The newly elected officers are: President, William Clinton Burling; Vice-President, R. M. Dickinson; Corresponding Secretary, Arthur A. Fisk; Recording Secretary, J. H. Russell; Treasurer, Thomas A. Bamford; Members of the Board of Governors, M. R. Rodriguez and W. H. Kirwin.

NATIONAL ELECTRIC LIGHT ASSOCIATION.

A meeting of the executive committee of the National Electric Light Association was held at the Murray Hill Hotel, Tuesday evening, September 10, with the following members present: C. H. Wilmerding, President, E. F. Peck, Vice-President, C. O. Baker, Jr., Master of Transportation, Charles R. Huntley, E. H. Davis, A. Markle, W. R. Gardener, G. A. Redman, J. J. Burleigh, John A. Seely.

A committee, composed of John A. Seely, E. F. Peck and A. J. DeCamp, was appointed to consider the matter of holding an electrical exhibition in connection with the Nineteenth Convention of the association, to be held in May, 1896, in New York. This committee was clothed with power to act, and will report as soon as possible to the full board.

"The Telegraph Age" has issued in connection with the visit of the Old Time Telegraphers to New York, a most interesting souvenir number, full of reminiscences, portraits of well known men, technical literature, reports of the proceedings, &c. It is every way admirable, and is without question one of the best issues of a telegraphic journal ever issued. Mr. Taltavall and his associates deserve the hearty support of the whole telegraphic fraternity.

LEGAL NOTES.

GEORGE MAITLAND ET AL vs. GENERAL ELECTRIC CO.—ROYALTIES ON INVALID PATENTS.

Judge Bischoff, in the Court of Common Pleas in New York City, on Sept. 9, handed down a decision involving an important question in regard to the recovery of royalties on patents of the Edison General Electric Company which the United States Circuit Court have declared invalid. The suit in which Judge Bischoff rendered his opinion was brought by George Maitland and the General Fixture Company against Henry P. Drew and John May. The plaintiffs sued to recover royalties due them from the defendants, who do business in this city under the firm name of Drew & May. The plaintiffs allege that on Nov. 1, 1891, the defendants entered into an agreement with Maitland and the Edison General Electric Company, by which Maitland and the Edison General Electric Company authorized and licensed the defendants to manufacture and sell electric light fixtures, combined gas and electric light fixtures, and other electric light appliances under twenty-six letters patent, in consideration of paying a royalty of three per cent. on all net sales. The royalties were to be paid quarterly. The plaintiffs allege that between October, 1893, and July 1, 1895, the defendants' sales amounted to $3,000 each quarter, and that there is due them $450 in royalties. Prior to the institution of the suit the plaintiffs allege that the Edison General Electric Company assigned their interest in the patents involved to the General Fixture Company.

The defendants filed an answer to the plaintiffs' complaint setting up by way of defense that the patents upon which royalties were demanded had been declared invalid by the United States Circuit Court, and that the plaintiffs, for that reason, had no cause of action. The defendants also filed a counter claim for $461, which they declared to have paid to the plaintiffs upon invalid patents. The plaintiffs demurred to this answer, and Judge Bischoff sustained the demurrer with costs. In his opinion Judge Bischoff says:

"It is well settled that a licensee of a patent under royalty contract cannot proceed to manufacture and sell the patented articles, and resist a claim for royalties upon the ground that the patents were invalid, unless he gave notice of his intention to repudiate the contract before the royalties accrued." He also held that the defendants could not recover the money paid by them.

SIEMENS & HALSKE ELECTRIC CO. vs. METROPOLITAN WEST SIDE ELEV. R. R. CO., CHICAGO.—THIRD RAIL LITIGATION.

There are two patents involved in suits brought by Siemens & Halske Electric Company against the Metropolitan West Side Elevated Railroad Company in Chicago. One is No. 324,176 and the other is No. 322,859. We quote the twentieth claim of the former patent and the twenty-first claim of the latter to show succinctly what the inventions are that are involved in these patents and which the Metropolitan West Side Elevated Railroad Company is infringing.

"20. The combination, substantially as herein set forth, of conducting-rails mounted on the side of the track, contact-springs fastened to the side of the car, a series of resistances, and a conductor connecting the springs with the series of resistances."

"21. In an electric railway, the combination, substantially as herein set forth, of a frame suspended beneath the car, having resistances connected together in series, a series of contact-plates electrically connected together, a contact-lever which makes the same connection with the contact-plates when moved a certain distance in one direction as when moved a certain distance in a reversed direction, and a contact-truck having reversible brushes and electrically connected with the contact-lever."

Siemens was a pioneer in electric railway work and anticipated in his inventions much of the present practice in that line.

SIEMENS & HALSKE ELECTRIC CO. vs BALTIMORE & OHIO R. R. CO.—OVERHEAD TROLLEY CONSTRUCTION.

Suit has been brought by the Siemens & Halske Electric Co. against the Baltimore & Ohio Railroad Company on U. S. Patent 530,274 which covers the system of overhead construction used in the tunnels at Baltimore in combination with contact devices and a motor upon the vehicle.

TO SUE THE AMERICAN BELL UNDER THE ANTI-TRUST LAWS.

The U. S. District Attorney in Chicago has been requested to bring suit under the Anti-Trust Laws, against the American Bell Telephone Co., in behalf of the people. Mr. James Keelyn, president of the Western Telephone Construction Co. and of the National Telephone Protective Association, is understood to be a leader in this action, and to have submitted evidence to U. S. District Attorney Black bearing on the case. Mr. Keelyn has for sometime past been seeking to make out a case of this nature, but bases his contention chiefly on the famous Bell-Western Union contract of 1879.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE TUDOR STORAGE BATTERIES.

Elsewhere in this issue will be found a description of the second large storage battery of the Tudor type installed in the Boston Edison Station by the Accumulatoren Fabrik Aktiengesellschaft of Berlin. This enlargement of the Boston company's equipment, now the largest in the country, indicates in an unmistakable manner the benefits to be derived from a battery installation in connection with every station working under variable load. The record of the Tudor battery in Europe is a most remarkable one and we understand that arrangements are now under way for the manufacture of this type of cell in the United States.

PROCTOR-RAYMOND ELECTRIC CO.

Messrs. Proctor and Raymond have bought the entire business of the Proctor-Raymond Electric Co., formerly located at Rochester, N. Y., and have re-established it at 444 Niagara street, Buffalo. They control the name, machinery, good will and patent rights, and will continue to manufacture the Eclipse iron box bell, the Rex wood box bell, and the Gravity Drop annunciator formerly made by the old company. In addition to these, they will make floor treads, spark coils, needle annunciators and other electric house and hotel furnishings, upon all of which they have special patents. They expect the cordial endorsement of the trade on the superiority of their product, and will be shipping goods by September 20.

E. P. ROBERTS & CO.

E. P. Roberts & Co., Cleveland, O., have prepared specifications for the municipal plant at Bellefontaine, O., for 100 arc lights, and 1,200 incandescent, the contract for which has been awarded to the Standard Electric Co., to furnish Standard arc machinery, Westinghouse alternating current, incandescent machinery, and Dick and Church engines. They are also at work on specifications for a municipal plant for Mt. Sterling, Pa.; and bids are now in, under their specifications, for a complete electrical and steam, including heating, plant, for a twelve story office building, in Cleveland. This plant will have about 1,500 lights, direct-connected dynamos, and the wiring will be partly moulding and partly conduit work. The above firm prepared also the specifications for the wiring of the Lucas County Court House, Toledo, O., for 1,500 lights, and two 15 H. P. motors, for ventilating purposes. The work is to be iron armored conduit, and the contract has been let to Bissell & Dodge, of Toledo, O. In addition to the above, they have recently prepared wiring specifications for a number of buildings, and also report business quite active along the line of office advice relative to inventions, and work as expert in patent causes.

NEW YORK NOTES.

THE E. A. BRIGGS COMPANY, of this city, has been formed to carry on a hardware, plumbing and electrical supply business, with a capital stock of $15,000. The directors are G. Briggs, E. A. Briggs and W. F. Dudley.

THE MANHATTAN GENERAL CONSTRUCTION COMPANY, of New York City, has been formed to manufacture machinery, electrical apparatus, and other goods; capital, $100,000. Directors: Charles B. Hill, Benjamin A. Gould, Jr., Cortland Betts, E. H. Floyd-Jones and N. H. Swayne, all of New York City.

MR. E. E. KELLER, of the Westinghouse Machine Co., has, it is announced, just returned from Europe with the exclusive American rights for that company for the manufacture of the celebrated Parsons steam turbine, which has made so remarkable a record in connection with high speed dynamos, giving great efficiency with marked economy of space, steam, etc.

MR. F. M. HAWKINS, New York agent of the Electrical Engineering and Supply Co., of Syracuse, has closed a contract for the switches and switchboard for the new Y. M. C. A. Building on Fifty-sixth street. The board contains 72 square feet of Italian marble mounted on polished brass supports. Its equipment comprises three 450 amp. main switches; 11 circuit switches ranging from 150 to 200 amp.; and Weston "R. P." ammeters and voltmeters.

"ELECTROZONE."—The excellent disinfectant made by the Woolf electrical process from salt water is having a great run, and deservedly so. The New York Board of Health has recently ordered it for the Willard Parker Hospital, and it is being furnished for the Spanish troops in Cuba as a good cure for yellow fever. It is also being shipped to the East as an antidote to cholera, and the latest order comes from Honolulu. The Electrozone Co. has its headquarters in the Morris Building, this city.

WESTERN NOTES.

MR. LOUIS OHNHAUS of Fort Wayne, Ind., has associated himself in the telephone construction business with Mr. G. W. Beers, and they have office rooms in the Pixley-Long block.

MR. GEORGE MATHER, formerly of the Thomson-Houston and Franklin Electric Companies, has become electrician of the Grand Avenue Electrical Works of Kansas City.

THE WESTERN UNION Co. has declared its regular quarterly dividend of 1¼ per cent. The earnings for September show an increase of $36,437 over the quarter in 1894.

THE Gates Electric Manufacturing Company has been formed at Chicago; capital stock, $25,000; to manufacture and operate electric light plants; incorporators, J. Holt Gates, William F. Camp, Jr., Adolph Lissen and D. V. Samuels.

THE WESTERN UNION Co. is paying $100,000 a year to the Southern Pacific Railway, but wants the amount cut as it is now meeting an active competition, which reduces its California income from these leased lines, etc.

THE BUCKEYE ELECTRIC Co. of Cleveland calls attention in this issue to the large number of responsible agencies handling its well known lamps, for the various sections of the country. The company is also issuing a new catalogue which it will be glad to send to any address.

MR. F. R. COLVIN has been inspecting various telephone exchanges in the west with a view to the detection of alleged infringements of the Western Electric switch patents, etc. Mr. Colvin represents Barton & Brown, the patent attorneys for the Western Electric Co.

FISHER & PORTER, of 1025 Monadnock Building dissolve partnership on Sept. 30. Mr. A. Fisher will retain the old offices and represent Wm. Todd & Co., of Youngstown, O., for their high grade and heavy duty engines, etc. Mr. H. F. J. Porter will retain the agency of the Bethlehem Iron Co. and move to room 1433 Marquette Building.

THE ELECTRIC APPLIANCE Co. is preparing in pamphlet form for general distribution Prof. Thomas' exhaustive test on the Packard lamp. This test contains information of special value to all lamp users, and can be studied with profit. It has attracted attention in England and been reprinted by the electrical press there.

MACCURDY & SMITH, of Indianapolis, succeed Morris & Mac Curdy, the dealers in and manufacturers of electrical specialties at 22 and 24 Circle street, that city. Mr. D. D. Smith has bought Mr. E. P. Morris's share in the business and joined hands with Mr. W. MacCurdy. A good deal of money has been spent in developing the business and they now hope for a return as times improve.

THE CENTRAL ELECTRIC Co., Chicago, are very busy sending out orders, and now that the days are shortening so rapidly, they find the sale of their Pharos Incandescent Lamps increasing to an extent that is highly satisfactory. The Central Co. also report that the demand for the well known Interior Conduit material is keeping steadily on the increase, and the numerous orders they receive for it, go to show how well it is liked by those who use it.

MR. J. W. MARSH, vice-president and general manager of the Standard Underground Cable Co., of Pittsburgh, paid a visit to Chicago last week. Mr. Marsh is very well pleased with the amount of business his company have done since the commencement of the year, and also states that their factory has been running night and day for some time past so as to enable them to supply their orders, and from the present outlook there is every probability of their working full time for the remainder of the year.

THE METROPOLITAN ELECTRIC COMPANY, of Chicago, report a decided improvement in business. "N. I. R." wire is still giving their customers the best of satisfaction, and in every instance meets the most exacting requirements. They recently received an order for twelve miles of their standard No. 6 N. I. R. wire. This order was placed, they say, on the merits of the different wires submitted. The selection of N. I. R. bears out the claim of the Metropolitan Company that their wire is strictly first class. The Metropolitan incandescent lamp is still a favorite with the trade. "P and B" products judging from the number of orders received still lead in insulating material.

THE OHIO STORAGE BATTERY Co.—Prof. D. W. Shea, of the Department of Physics and Electrical Engineering, at the University of Illinois, writes the Ohio Storage Battery Co., of Cleveland, O., as follows: "Please furnish the Department of Physics and Electrical Engineering with 100 Ford-Washburn storage cells in glass, type 6 G of 150 ampere hours capacity each, the time of shipment to be such that we may receive the cells by the middle of September. My experience with them thus far, and the favorable comparison of these cells with the other types which we have already in use, show them to be the most satisfactory thing for general purposes that there is now on the market. I sincerely hope you may meet with the success in your business that you deserve, if the cells which you are now manufacturing are as good a quality as the five which I have had in constant and hard use during the last three years."

NEW ENGLAND NOTES.

THE CABLE STEAMER "MINIA," Capt. S. Trott, is again in port, at Boston, and welcome as ever. She has been splicing the Duxbury and St. Pierre Miquelon cable.

WADDELL-ENTZ CO.—Mr. V. H. Hewes, receiver, gives notice of the sale of all the above Company's patents, property, &c., at Bridgeport, Conn., on Sept. 30.

BOSTON LIGHTING.—A special committee of the Boston Common Council has been on a junket investigating the subject of municipal lighting, in order to determine whether it is worth while going in for a city plant.

THE ELECTRIC STORAGE BATTERY Co., has closed a contract for a battery to be used in the Edison Station at Lawrence, Mass. The battery consists of 140 cells and will be discharged at 100 amperes for about three hours to assist the generating plant during the period of heavy load.

THE BRADBURY-STONE STORAGE BATTERY Co. have made a satisfactory deal with the Electric Storage Battery Co. of Philadelphia, and will hereafter have the handling of the Chloride accumulator in their New England territory, which presents many favorable opportunities for storage battery work.

THE SHAWMUT FUSE WIRE Co. have removed their office and factory from 161 High street, to 93 Federal street, Boston, where they will be glad to see old and new friends and where they will carry a large stock of fuse wires, links, ribbon, terminals, blocks, etc., as well as small motors, station switches, etc.

THE DIAMOND MACHINE Co., Providence, R. I., report that they are at work on a large number of machines for special purposes, such as grinding cutters of large surface; and that they are manufacturing several large orders for surface grinding and polishing machinery of the new pattern, in which the wheel is below the table.

HARTFORD, CONN.—The new car barn for the Hartford Street Railway Co., of Hartford, Conn., will be designed and built by the Berlin Iron Bridge Co., of East Berlin, Conn. The office will be located in the front end of the building on State St., with the barn in the rear. The whole construction is to be of steel and fire-proof, the roof being covered with the Berlin Iron Bridge Company's patent anti-condensation corrugated iron roof covering.

MR. GEORGE H. R. PREBLE of Boston, has been elected acting superintendent of the Fitchburg & Leominster Street Railway and assumed his duties last week. He is 35 years old, and has been connected with electrical enterprises since 1887, when he was with the Sprague Electric Motor Company of New York, in the construction of the Union Electric Railway of Richmond, Va. He was construction superintendent of the Tacoma Street Railway Company for two years, and has been in the employ of the Thomson-Houston and Edison electric companies since.

SOUTHERN NOTES.

THE AMERICAN ELECTRIC CONSTRUCTION & SUPPLY Co. has been organized at Parkersburg, W. Va., with a capital stock of $100,000. The incorporators are W. Clay Leonard, Jr., president; H. L. Hickey, C. V. Webber, W. L. Leonard and J. H. Hopkins. The company propose to plan and build all kinds of electric systems and to maintain a regular electrical supply house to handle the staple goods.

PHILADELPHIA NOTES.

THE HORN & BRANNEN MFG. Co., of Broad street, Philadelphia, are placing a splendid line of new electric, gas and combination fixtures on the market. They make a special feature of beauty and solidity, but maintain moderate prices throughout. They will be glad to send their literature, with cuts, etc., to anyone interested, and especially to those putting in new central stations and isolated plants. A large amount of fine work is entrusted to their hands, and one of their latest contracts of this nature is the fitting up of the great new Philadelphia Bourse, which is to be one of the most handsomely illuminated buildings in the country.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

Vol. XX. SEPTEMBER 25, 1895. No. 386.

THE WILKES-BARRE, PA., ELECTRIC LIGHT CO.'S NEW STATION.

BY

J. H. Vail

INTRODUCTORY.

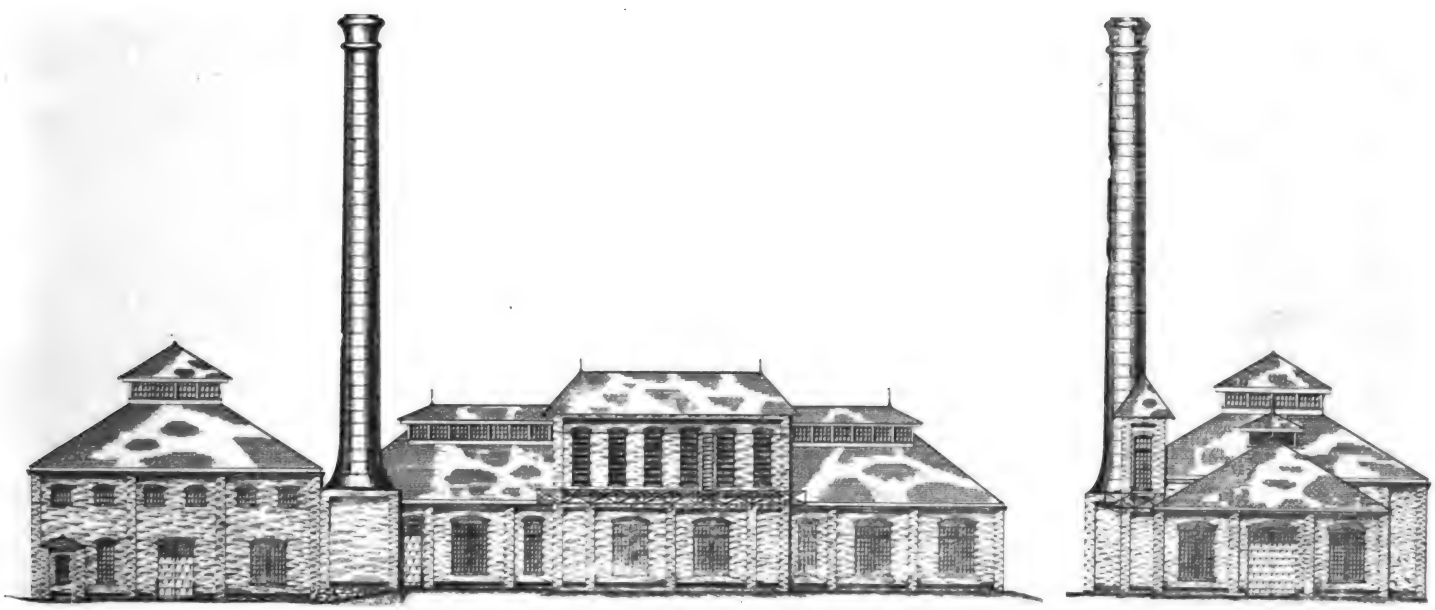
THE Wilkes-Barre Electric Light Company is an original licensee of the Edison Electric Light Company. The first central station was constructed near the electrical centre of the town and put into operation in the year 1887, and was first intended to supply incandescent lights to the business district of the city. At a later date, an arc light system was added. The load connected on the present Edison three-wire system of distribution is 6,500 incandescent lamps, and 50 horse power of electric motors; and on the arc system, 160 all-night arc lights for street lighting, and 140 six-hour arc lights for commercial lighting.

Under the efficient management that has prevailed in the business of the Company, a very satisfactory cash surplus has been accumulated, awaiting the inevitable demand for improvements and increased facilities. In the meantime, the centrally located real estate on which the present station was erected has increased considerably in value, until at present it is at least twenty times more valuable than the new site recently selected.

The limits of capacity of the present location and station equipment have been reached; and for some time it has been a question as to how an extension of the business could most economically be effected. In determining upon a new site for the construction of a new station, several important factors were necessarily considered. The point of prime importance was the cost of fuel. Several sites were offered and made most attractive to the company and in each case their value was carefully analyzed. In addition to the question of fuel, the cost of water for boiler feed is an item of much importance. A thorough investigation of all the sites offered resulted in the selection of the new location 8,200 feet distant by pole line route from the old station, situated on the bank of the Susquehanna River, at an elevation of 25 feet above the river.

This location has several excellent inducements in its favor. There is an abundant supply of low grade coal in a large anthracite culm bank immediately surrounding the new station. This is obtained at a nominal price per ton, as compared with the cost of coal in the old location. When this supply is exhausted contracts already made permit of a continuation of supply of pea coal, which can be dumped direct from the mining cars into the coal pockets of the company, at very favorable prices. The water supply for the station is secured from the Susquehanna River without cost, care being taken to locate the suction pipe at such distance from the shore as to secure pure water. There is abundant space surrounding the station to permit the dumping of ashes without extra cost for several years in the future. With a new station established in this location, it is quite evident that electric energy can be manufactured at a low first cost which can be rivaled only by water power.

It is an interesting and important fact that the wisdom of locating the early electric light stations near the centre of distribution has in a large number of instances been of large benefit to the local company in that, while a profitable business has been established, the mere real estate investment has of itself paid handsome returns. At the present time, however, the necessity of reaching out to points far

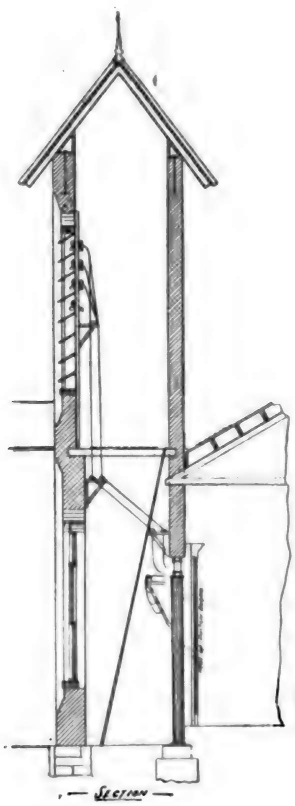


THE WILKES-BARRE, PA., ELECTRIC LIGHT CO.'S NEW STATION.—FRONT AND SIDE ELEVATIONS.

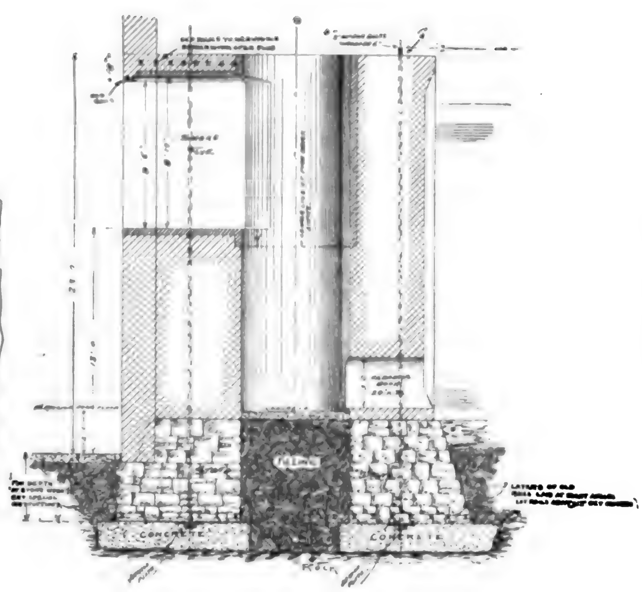
distant from the station has caused the development and invention of improved systems of distribution; and there are now, no doubt, many other electric light stations that could be removed and reconstructed with profit. New and low cost real estate could be selected; and by the application of the booster system to the three-wire system serving present consumers, the introduction of an alternating system for new customers, and a series arc light installation for street lighting, it would seem that an old station could be so developed as to find a wonderfully enlarged sphere of usefulness and profit for many years to come.

THE NEW STATION BUILDING.

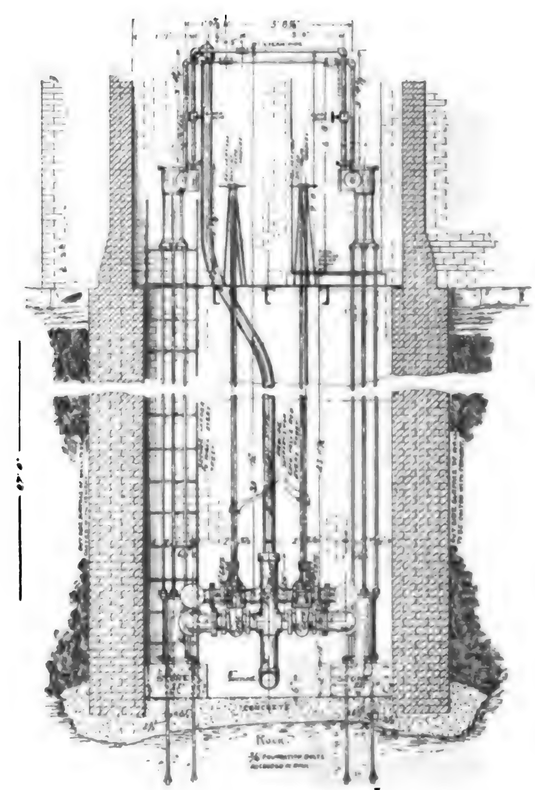
The new central station building of the Wilkes-Barre Electric Light Company, views of which are shown on page 293, is of nearly fire-proof construction All walls are of brick, laid in cement mortar. The roof structure is of iron, covered with heavy planking, felt and blue slate. The floors are of concrete.



The Wire Tower.



Foundation of Smoke Stack.



Deep Well Pump.

The design of the building and arrangement of plant were prescribed by the dimensions of the property coupled with the necessity of obtaining secure foundations on bed rock. Under the south-west corner of the boiler house, the stone foundation is twenty-eight feet deep, this being necessitated by the finding of an old mill site, established about 100 years ago, and long since covered from view. Apparently there is now ample ground room around the building but, as a fact, the foundations were carefully staked out in advance of all excavation and the front wall of the building stands back but two and one-half feet from a rocky cliff some 20 feet high. All the ground space now appearing in front of the building is made ground, having been filled in from the excavation of the culm pile and rock and soil underlying the same.

In preparing the site for the construction of the building, the quantities of material removed were as follows: 12,558 cubic yards culm, 213 cubic yards wet ashes, 1782 cubic yards shale, 646 cubic yards rock. The foundations contain 87,760 cubic feet of stone masonry and 2,997 cubic feet of concrete, all laid in best cement mortar.

The new building, shown in plan on pages 296 and 297, is 206 feet long outside measurement, and 66 feet wide, at the boiler house end. The boiler house is nearly square, measuring 66 feet by 61 feet and is 26 feet high from floor to under side of roof truss, and 53½ feet from floor to apex of ventilator.

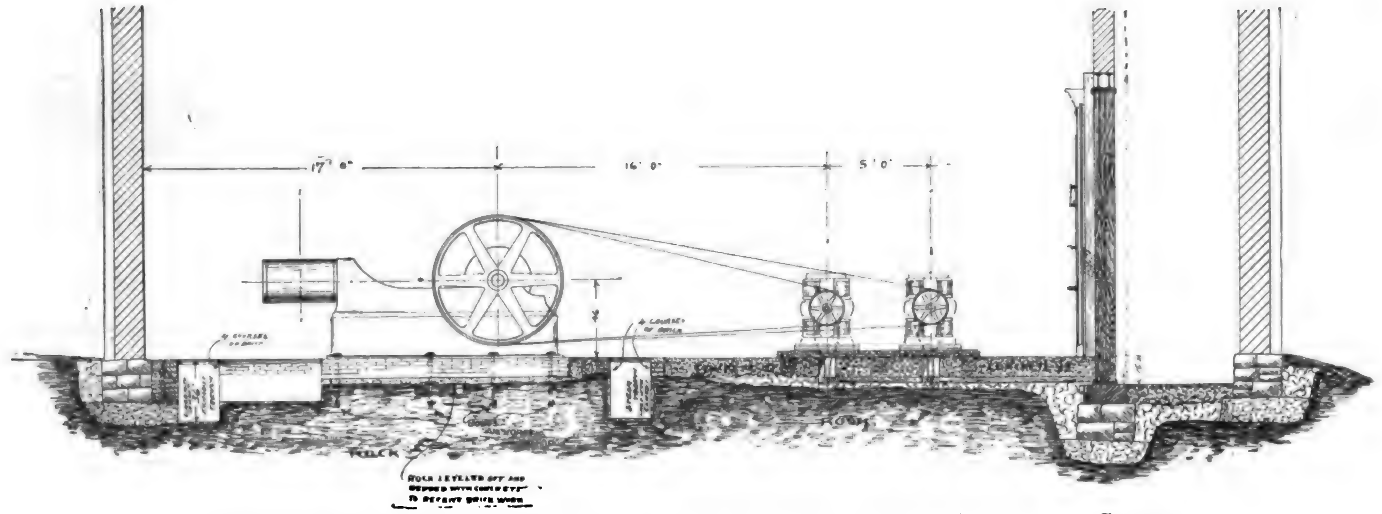
The boiler house is designed to conveniently accommodate 2,000 H. P. of water tube boilers, arranged in four batteries of 500 H. P. each. Ample space is provided for convenient passage all around the boilers for cleaning purposes; the fire room between batteries being 20 feet wide. It is intended to install coal storage reservoirs and a system of automatic coal delivery in the near future.

Adjoining the boiler house is the engine and dynamo building. The inside dimensions are 46 feet wide by 144 long and 17 feet from floor line to under side of roof truss. The floor line of the engine room is three feet above the boiler room floor level.

The engine room is fitted with a traveling crane, 35 feet span, of capacity to lift and transfer a 5,000 lb. load. The run-way for the crane is suspended from the roof trusses.

Passing from the boiler room we have on the left hand a large room designed for the pumps and feed water heater, reserve water tank, etc. On the right hand, is the employees' toilet room, conveniently fitted with individual lockers, water closets, wash sink, etc. Next is the oil room, containing the appliances for the oil circulating system, reserve supply, etc.

As will be observed from the plan, the switchboard forms a continuation of the wall of the engine and dynamo room. A door at either end gives convenient access to the rear and to the wire tower, which is a structure projecting beyond the face of the main building, and is 7 feet wide by 50 feet long, and 46 feet, two stories in height. The second story platform of the wire tower, shown in section on this page, is of hard, pine slats, laid on iron I-beams, and is reached by an iron ladder. The floor of



ENGINE ROOM, WILKES-BARRE ELECTRIC LIGHT CO'S. NEW STATION, TRANSVERSE SECTION.

the wire tower is 18 inches below the floor level of the engine room, permitting the conduits containing dynamo cables to pass freely under the switchboard and affording most convenient facilities for making connections in the rear.

THE STEAM PLANT.

The present steam plant consists of four 225 H. P. Stirling water tube boilers, set in two batteries, and nine high speed automatic cut-off engines; two deep well pumps, two boiler feed pumps and one Webster vacuum feed water heater.

The exceedingly low cost of coal is a feature that at the outset of this construction was carefully and repeatedly analyzed in order to compare the original cost and economies that would be obtained by the use of the many appliances generally utilized for the saving of fuel. As a result, some types of apparatus that would be beneficial in other stations, differently located and paying a higher price for coal, were found to be of but little value in this station. As previously stated, the site of the new power house is located near the shore of the Susquehanna River. The boiler feed water is pumped from the Susquehanna River by a pair of Worthington deep well pumps. A suction pipe, with strainer and foot valve, was laid to the middle of the river and protected at the extreme end by heavy crib work. This pipe is some 550 feet in length and has a rise of not exceeding 15 feet to the water cylinders of the

METHOD OF RUNNING DYNAMO CONDUCTORS.

pumps. The steam cylinders of the pumps are located above the engine room floor line.

In order to accommodate the deep well pumps, a well has been constructed at the side of the boiler house, in which the pumps are conveniently erected and are readily accessible. The arrangement of deep well pumps is shown on page 294.

The Stirling boilers are fitted with McClave shaking grates and Argand steam blowers, by means of which combination and a strong natural draught the burning of anthracite culm, or other low grade coals, can be accomplished with success and economy.

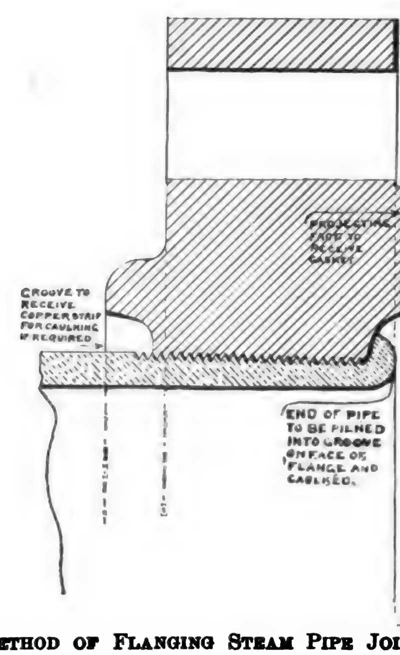
THE SMOKE STACK.

The stack is of steel plate, as follows:

30 feet shell from base up, $\frac{5}{16}$ steel plate.
40 " " $\frac{1}{4}$ " "
30 " " $\frac{3}{16}$ " "

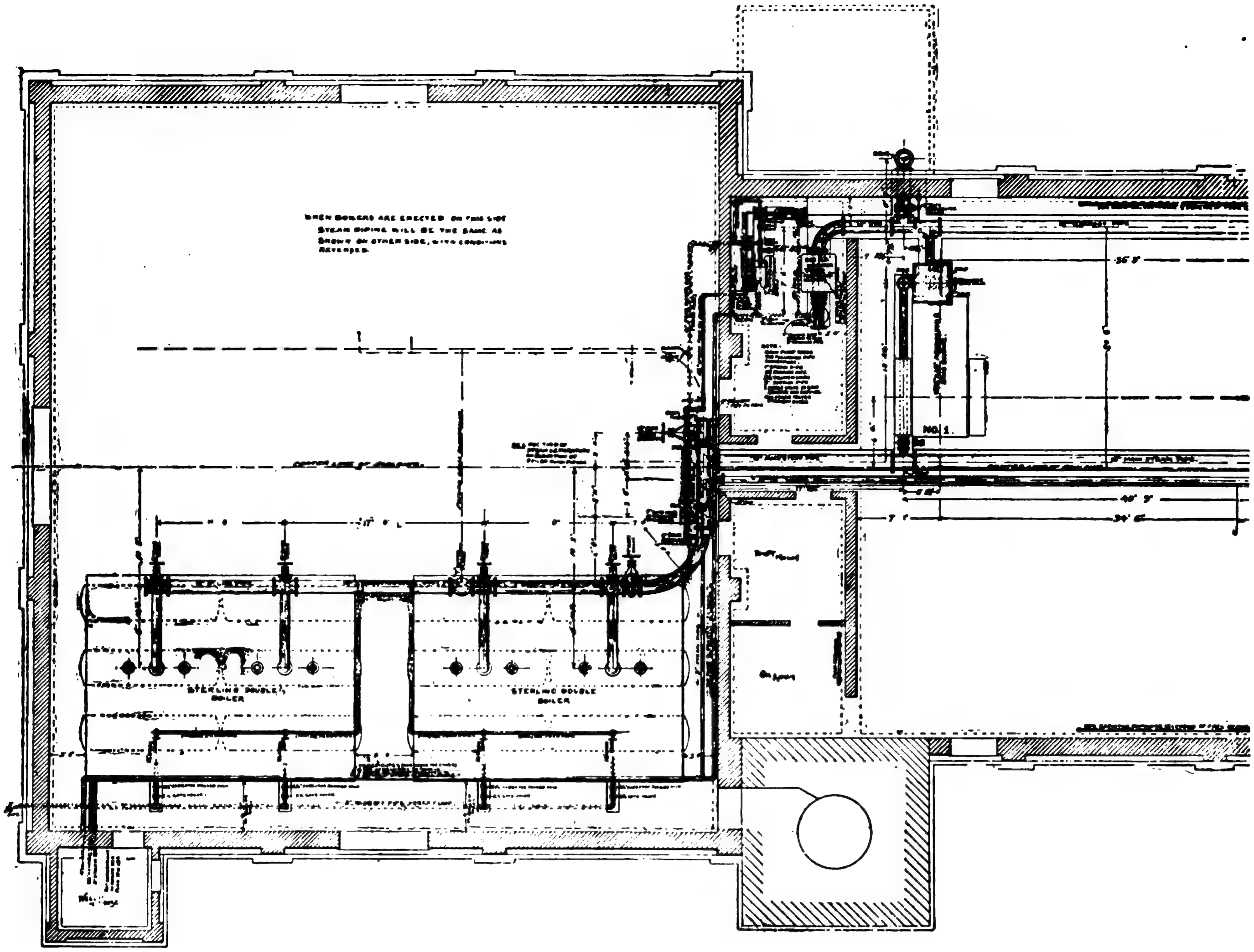
The total height above the base is 100 feet, and above grate bars 120 feet; diameter of shell on top, 84"; diameter of shell at base, 90". Lining, 4 inches red brick throughout; interlining, 4 inches fire brick 20 feet above base; inside diameter at top, 75 inches.

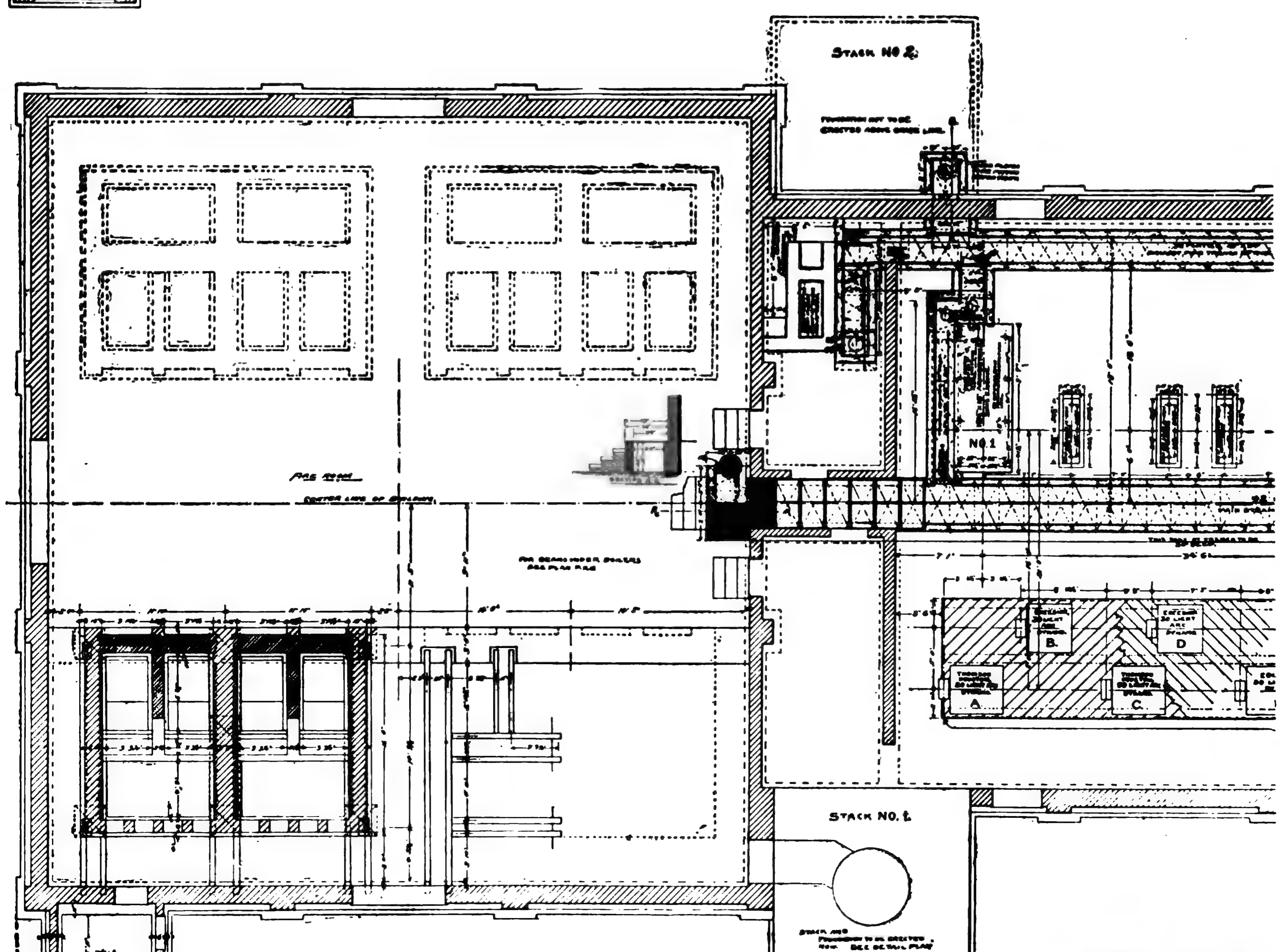
The stack foundation (page 294) is started upon bed rock with eighteen inches of concrete. The foundation bolts, six in number, 2 inches diameter by 23 feet long, are set in the concrete, and have boiler plate washers two feet square. Two courses of T rails, laid at right angles and filled in with concrete, serve to distribute the strain over the entire foundation. Several courses of stone work are



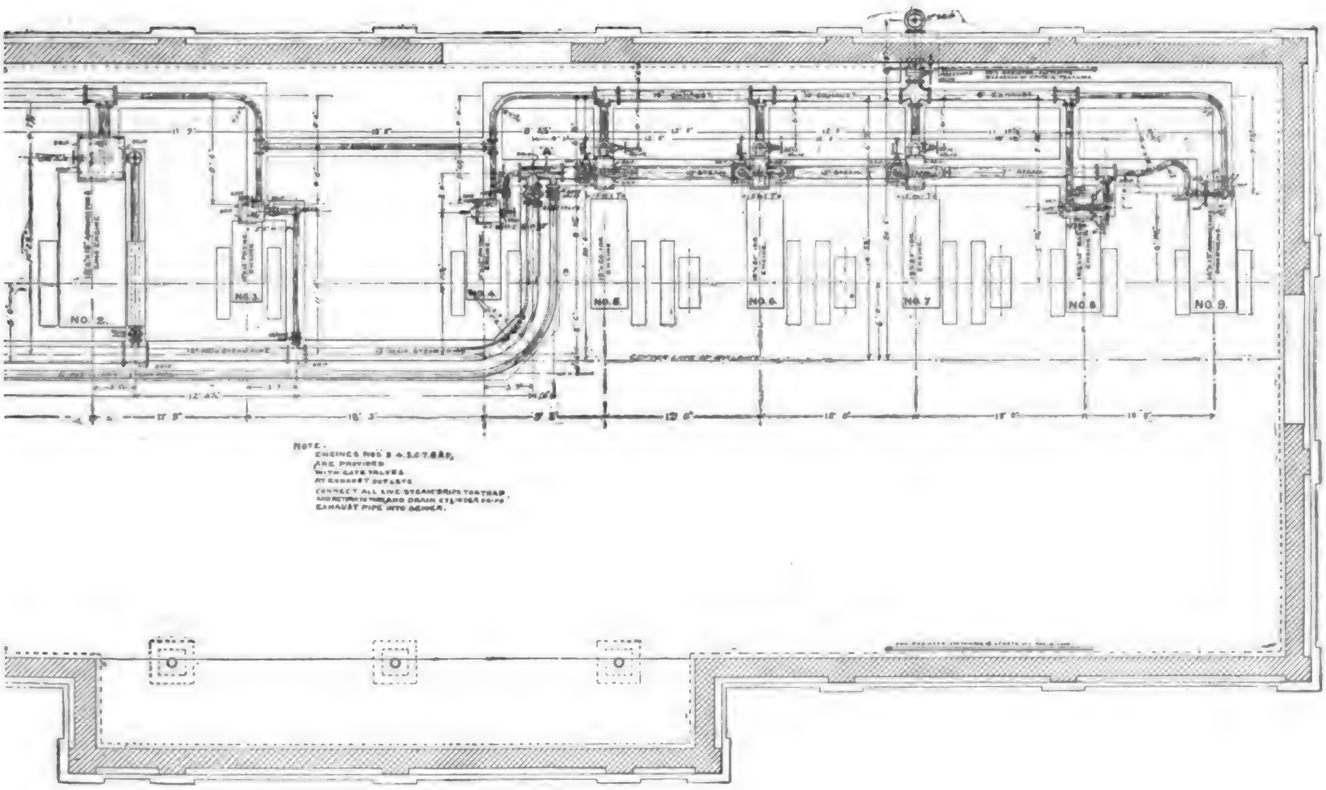
METHOD OF FLANGING STEAM PIPE JOINTS.

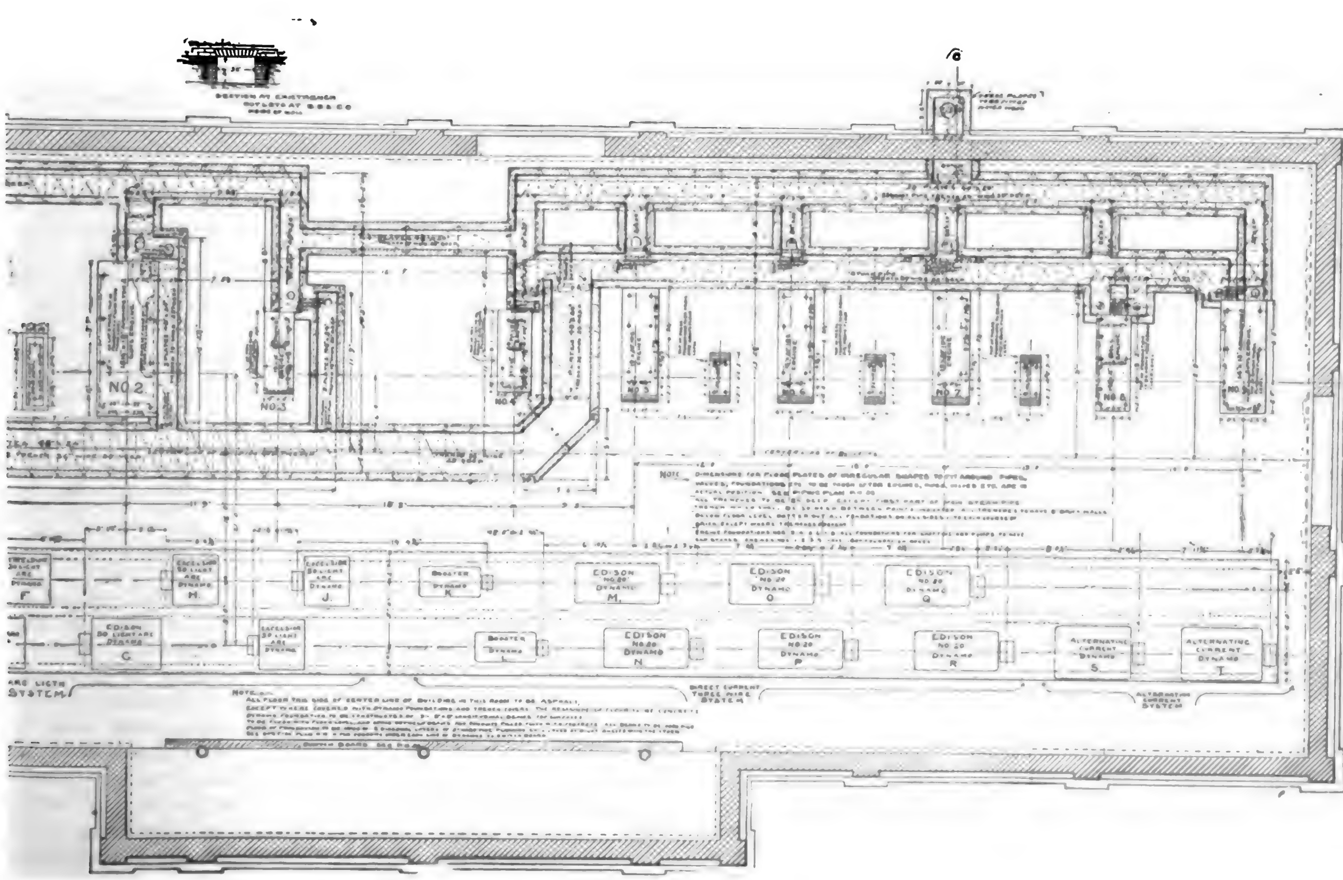
lnext aid, the base of the stack being constructed of brick, laid in cement mortar. 95,000 bricks were used in the base. The stack has an outside ladder reaching from foundation


STERLING DOUBLE BOILER
STERLING DOUBLE BOILER
NO. 1


STACK NO. 2.
NO. 1
A.
B.
C.
D.
STACK NO. 1.

P.H. 6





Plans of The New Central Station of The Wilkes-Barre Electric Light Co.

to top. It is intended that a second stack, duplicating the first, shall be constructed when the present capacity of the station is increased.

THE ENGINES.

For driving the arc light system, two 18½ x 18 inch Armington & Sims engines are used, being arranged with an intermediate shaft and friction clutch pulleys, so fitted that either engine may be used to drive the several dynamos. Aside from these two new engines, the following engines from the old station are used: Two Payne engines, three Ide engines, one Ball engine, one Armington & Sims engine.

All the above were in such excellent condition that it was not considered desirable to dispose of them at present at the low prices that could be obtained. The exceedingly low price of coal warrants this until such time as large increase of business demands greater capacity.

PIPING.

Because of the extreme length of the building and corresponding length of piping system, special precautions have been taken to provide against accident from expansion and contraction by securing a flexible system. Wrought iron bends have been freely applied. The entire system of steam and exhaust piping is wrought iron, lapwelded pipe, heavy flange joints being used on all sizes above 3½ inches, (page 295), and all pipes in the engine room being laid in trenches below the floor line. With this method, ample support is obtained for the heavy piping and the dangerous effects of vibration are entirely avoided.

THE DYNAMOS.

The dynamos are as follows:
Ten 50 light arc machines,
Six Edison bi-polar type, No. 20 machines,
Two new booster dynamos 27 K. W. capacity,
Two alternating dynamos.

Two new 50 light arc dynamos are added; also a 1,000 light alternating dynamo; otherwise, the dynamos from the old station are used. It is intended to develop the increase of incandescent business with the alternating system. When the business expands largely beyond its present limits, the ample space in the engine room will permit the removal of belt driven apparatus and the substitution of direct driven dynamos and engines.

SWITCHBOARD.

The switchboard is divided into three sections, accommodating the arc, the three-wire incandescent, and the alternating incandescent system. The board is constructed of a heavy frame of Georgia pine, mounted upon a substantial brick foundation. The body of the switchboard is constructed of terra cotta hollow brick, 6 x 8 x 12 inches, laid up in a twelve inch wall, the face being finished perfectly smooth with adamant plaster. The windows in the wire tower are fitted with stout cross beams to which are secured the pins and insulators carrying the main conductors leading to the pole line. All conductors leading from the dynamos are flexible cables drawn through Interior Conduit Company's telescoped tubes, laid under and parallel with the dynamo foundations, as shown on page 295.

THE BOOSTER SYSTEM.

The booster system has been a very material aid in permitting the location of the station so far distant from the mains of the three-wire system of distribution.

In order to determine the beneficial effects from the application of the booster system in this station, the load records for a year back were secured and carefully plotted diagramatically. With the conditions of the daily load required from the station during the different months of the year and from other features of the operation of the system known, it is calculated that the boosters are to be cut in on the feeders when the load reaches 300 amperes per side and the boosters will be required to build up the pressure proportionately through a range of from 300 to 600 amperes per side, under the following conditions: At 300 amperes, the booster voltage should be 0; at 400 amperes, 8 volts; at 600 amperes, 17 volts; and at 600 amperes, 25 volts. Thus the boosters will be depended upon to raise the pressure 25 volts at full load.

Under these conditions, the bi-polar Edison dynamos will take care of the load up to 600 amperes on each side of the system and the boosters will be cut in for such hours of the work as the load may be above 600 amperes, and may again be disconnected when the load falls below this amount; thus in this particular case, the boosters are used to raise the potential on all the feeders of the system. While the boosters that have been applied in several stations have been direct driven by large electric motors, it was determined in this station to drive both boosters by belts from a high speed engine. The application of the booster system in this station realizes a saving of about 50 per cent. of the copper that would otherwise have been required in the new feeders of the three-wire system and correspondingly reduces the cost by several thousand dollars; in fact, the cost of the application of the booster system is almost nominal as compared with the reduced investment in copper. The use of the booster system also realizes a large annual saving in operating expenses.

The copper conductors leading from the station are supported on a pole line of very substantial construction, all the poles used being 45 to 50 feet in height. The conductors of the alternating system are placed on the upper cross arms; the conductors of the arc light system are on the centre cross arms, and the feeders of the three-wire system on the lower cross arms. All the wires are covered with heavy weather-proof insulation.

THE QUESTION OF FUEL.

Before closing this description, it seems desirable to invite attention to the fuel question as being one of more than ordinary importance to all central stations.

The economical use in this station of low grade coal at small cost permits the original production of a horse power per year at less cost than the same can be produced from many water powers where is required an abnormally large original investment for development, and consequent enormous annual interest charges. From the very thorough investigations and experiments of the late Hon. Eckley B. Coxe, of Drifton, Pa., to determine the steam producing value of low grade coal, the following results are selected as showing the amount of water evaporated from different sizes:

Anthracite Coal.	Pounds of water per pound of coal from and at 212° F.	Pounds of water per pound of combustible from and at 212° F.
Buckwheat	8.77	11.07
Rice (No. 2 Buckwheat)	9.05	11.18
Culm,—pea, buckwheat, rice and dust.	8.74	11.19
Barley (No. 3 Buckwheat)	8.39	10.89

In view of the fact that in most cities the cost of fue is from 40 per cent. to 60 per cent. of the operating expenses of a central station, the writer believes that a more thorough investigation of the burning of low grade fuel will show that the culm piles of the Pennsylvania coal mines and the low grades of cheap coal that are there constantly mined, offer even more attractive opportunities for the investment of capital than the enormously costly development of the same horse power of water. Under the favorable conditions that can be obtained in many localities, the erection of large central stations for the generating of electric power on a large scale will permit the production of one horse power per year, 365 days

of 24 hours each, for a surprisingly low cost per year. These localities are equally desirable for the establishment of large manufacturing centres. Another advantage is the promptitude with which a steam power station can be prepared for business and operation, thus saving interest on a large invested capital lying idle for a long period awaiting completion of plant.

In considering this question, the fact must be appreciated that in cities distant from the coal mines, the cost of transportation is many times greater than the cost of a good grade of coal at the mining centre.

In comparing the type of station referred to in the foregoing, it must be understood that the station should be situated in a locality that has all the essential features for the cheap production of power as well as a market for the produced electric energy from the station. In selecting localities of this kind, it will also be found that local authorities will offer extraordinary inducements in the way of reduced tax rates for long periods, in order to attract investment of capital in such enterprises.

In connection with the construction work above outlined, it is a pleasure to acknowledge the cordial co-operation of Mr. A. E. Winchester, in the preparation of the working plans for steam and electrical work; also of Mr. Harry Van Benschoten in preparing architectural plans.

SMELTING REFRACTORY ORES IN THE ELECTRIC FURNACE.

BY

Geo. D. Burton

Geo. D. Burton.

Having devoted a part of my time for the past three years to the reduction or treatment of ores by electricity combined with a liquid solution, I have discovered, where the ore is of a rebellious character, that by placing proper flux in the solution the metal in the ore will separate and run from the ore according to the different degrees of heat required to melt the different metals. In treating ore containing lead, copper, gold and silver, the lead will separate first and be found in the bottom of the tank in globules, having the appearance of shot. As the heat increases the silver will follow, then the copper and then the gold, the rock finally being consumed or reduced to an ash. Each metal thus separated will be found in the bottom of the tank in separate particles or globules of its own kind. By the employment of a direct current of 2,000 amperes and 250 volts where the ore contains 20 per cent. to 30 per cent. of rebellious substances, the above current will treat one ton of ore at a time and requires from 35 to 40 minutes. The ore is placed in a receptacle which withstands a high degree of heat, each receptacle holding about a ton of ore, the number of ore receivers used determining the capacity of the plant. Each ore receiver, or receptacle, can be worked separately, or they can all be worked together—and supplied automatically.

Within the last two months I have treated in California many hundred samples of ore from probably as many different mines, with the invariable experience that the chemical properties contained in the ore have much to do with the rapid heating of the ore, and that the more rebellious the ore the less current required to treat it, as the rebellious substance tends to increase or create heat necessary to cause the metal contained in the ore to separate from it when the proper flux is used in the solution.

While in California I found no rebellious ore which this process could not handle successfully. I have separated, from various samples of rock, gold, silver, copper, lead, zinc, antimony, etc., and all of the bi-products, such as arsenic, sulphur, etc. The process proves a great saving in the operation of mines. Water power that is in close proximity to many mines can be utilized to generate the electric current required, which could be conducted direct to the machine at the mine and the ore treated at that point, thus saving the expense of the smelter and the transportation from the mine to the smelter. By this process none of the metal contained in the ore is wasted or lost; every particle of metal contained in the ore is found deposited in the bottom of the tank below the receiver; it then requires the ordinary furnace heat to convert it from its globular form into bars, pigs or ingots.

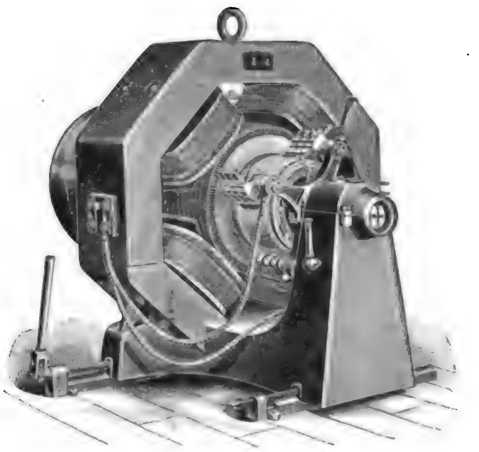
In some places in California I was informed that the smelting charges are about $17.50 per ton and that the railroad transportation charges are about $17, making $34.50 per ton the actual cost of getting the metal from the ore by the present process, showing that the mine must average about $50 per ton in order to make it pay. By my process all this expense can be saved by utilizing the water-power now passing by the mine and smelting the ore at the mine; and there are hundreds of mines in Colorado, California, Idaho, Montana, Utah, etc., that are so situated that water power can be utilized for extracting all of the valuable properties contained in the ore.

Remarkable success has been achieved in Canada in the treatment of nickel ores by this system. Canada contains almost the entire visible supply of nickel ore in the world. With an experimental smelter erected at 42 York street, Toronto, there was produced a "Nickel Matte" containing 27.5 per cent. pure nickel. It is officially stated by the Ontario Government that a nickel matte of 21.25 per cent. nickel is the best that the mining companies in Canada have been able to produce, and it takes them, by their present process, about 4 months to produce this matte, whereas by this system a ton of nickel ore can be reduced in about forty minutes.

Some years ago the United States Government sent Commodore Folger and Lieutenant Buckingham to Canada to investigate and ascertain the visible supply of nickel ore, with a view to its use for naval armor. These gentlemen stated in their report to the United States Government that there was 650 million tons of nickel ore in sight in Canada. As there are abundant water powers unused in the nickel district in Canada, and as the present price of nickel is about 35 cents per pound, it is estimated that by the use of this process the price of nickel can be reduced to 15 cents per pound, allowing it to be used in hundreds of ways not heretofore attempted.

The same current and solution is used for heating picks, axes, drills, and, in fact, all tools usually found about a mine. The pick point, drill, or the blade of an axe, can be heated and drawn to a fine edge or point; then, by raising the metal holder from the negative pole, the article heated is cooled and hardened in the same tank or solution in which it was heated, thereby dispensing entirely with coal, so difficult to obtain at many of the mining camps.

The generator to be used with this process is that manufactured by The Eddy Electric Mfg. Co., of Windsor, Conn., whose long experience with machines for electro-metallurgical purposes has especially fitted it for producing machinery for this work. The machine, illustrated in the accompanying engraving, is of the multi-



Eddy Generator Used in Burton Smelting Process.

polar type, with four steel poles bolted to a cast iron frame. On these polar projections are placed the exciting coils, which are shunt wound on metal spools. The armature is of the iron clad type, laminated and ventilated, and with a winding of copper bars laid in slots cut in the surface of the core. The end connections of these bars are so arranged and connected that conductors of extreme potential difference have a maximum insulation and separation.

The commutator is large and composed of hard copper segments held in place by collars. These collars are bolted together and may be tightened by a wrench while the armature is in the machine, should it ever become necessary. The usual rocker arm is supported by the front bearing, and holds the brush studs and brushes. The bearings are self-oiling and self-aligning and are very heavy. The machine is designed to carry 480 amperes at 350 volts, but the voltage may be reduced to a considerable extent by means of the field rheostat.

Electric Lighting.

THE ELECTRIC LIGHTING CONTROVERSY AT BLACKSTONE, MASS.

Reference has already been made in The Electrical Engineer to the curious situation that has developed in regard to the electric lighting of Blackstone, Mass., by a company in Rhode Island, and the question is so important that it has been deemed worth while to present a careful résumé of the affair.

The Woonsocket Electric Machine and Power Company is incorporated in the state of Rhode Island with its principal place of business in the city of Woonsocket. In 1890, by a special legislative act, the company was authorized to acquire pole locations for electric light purposes in the town of Blackstone, in Massachusetts, adjacent to the city of Woonsocket. By this act the company was required to appoint an agent in the town of Blackstone for the service of legal processes with the same effect as if the company were established under the laws of Massachusetts. It was also provided that any failure or neglect continuing for fourteen days after the demand upon or notice to such agent to comply with the decree of the court against the company should be deemed sufficient ground for the forfeiture of its rights in the town, which forfeiture might be enforced by information brought by the Attorney-General of Massachusetts. The selectmen of the town were also authorized, upon the failure of the company to comply with the provisions of the act admitting it, to revoke any permits given and order the poles, wires and other fixtures to be removed from the streets, and, if not removed within a reasonable time, they were to be forfeited to the town.

Very soon after the passage of this act the company and the town made a contract for five years for full arc lights at fifty cents per night, burning all night and every night in the year. Before this contract expired, negotiations were begun for its renewal but the parties were unable to agree upon a price, the town being unwilling to accept the price, the company refusing any reduction. One of the reasons for such refusal was stated to be that the company was receiving that price from the city of Woonsocket under a contract with two years more to run and that they could not afford to make a lower price to Blackstone during that contract's life.

The town authorities therefore applied to the Massachusetts Board of Gas and Electric Light Commissioners to fix the price. Ample provision for the exercise of this jurisdiction on the part of the Board exists as respects all Massachusetts companies and the Board, assuming that the same statutes gave it equal jurisdiction over so much of the business of the Woonsocket Company as was within this State, heard and decided the petition. At the hearing, the company, having been duly notified, appeared and was fully heard, making no objection at the time to the jurisdiction of the Board. After the hearing and before the decision, in view of the peculiar conditions surrounding the case, the Board endeavored to bring about a settlement of the controversy by the parties interested and negotiations looking to that end were carried on for some time; but the Board was finally notified by both parties that an agreement was impossible. The Board then made a decision for the price of forty-two cents per light per night and accompanied this with a brief statement of its reasons.

After the order as to the price had been passed by the Board, the company, not unexpectedly, declined to accept the provision and on July 15th, the date when the order was to go into effect, discontinued the lights and refused to further supply them. The five years' written contract, above referred to, had expired several weeks previously and the lights had been continued by the company under temporary contracts with the town.

After this refusal by the company, the town authorities applied to the Board for an order to compel the company to supply. A hearing upon this application was ordered and the company appeared and then objected to the jurisdiction of the Board. This question was argued, evidence relative to the merits of the case was heard and the Board found that it had jurisdiction under the statute and issued its order for a compulsory supply. The company has refused to abide by the provisions of the order and the matter has been placed in the hands of the attorney-general of Massachusetts for such action as he may think proper. The reference to this officer is a recent one and no action has yet been taken by him.

INVERTED ARC LAMPS IN A WORSTED MILL.

The following exceedingly interesting letter, by Mr. D. L. Goff, on the use of inverted arc lamps in mills was read at the last meeting of the New England Cotton Manufacturers' Association:

In answer to your inquiry regarding our experience with the inverted arc lamp, and the economy of this method of lighting by reflection, we have to say that after a year's trial we are simply delighted with the perfection of the illumination, and the saving in cost of maintenance over gas or incandescent lamps. We have had 42 inverted arcs in use during the past winter, and before next winter intend to equip our entire works. We find that the cost of installing 100 incandescent lights, or their equivalent illumination in arc lamps, is about the same, with the present low price for arc lamps. The cost of maintaining the arc lamps at the present price of carbons, and including interest, is about the same as renewals on the incandescent plant. In favor of the arc lamps, you must remember that they are always up to full candle power, while the incandescent lights begin to deteriorate from the moment they are put into service, and as they are generally allowed to burn too long, the result is, the illumination becomes very unsatisfactory. There is another serious fault with the incandescent light for mill use (that is for worsted mills, for I know nothing about its use in cotton mills), which shows itself in an oily scum depositing on the outside of the glass bulbs, and of the same character as we find on our window panes, which require washing every year with strong suds. This greasy deposit on the bulbs readily collects lint and particles of dust floating in the air, and the result is, the light is very materially decreased, unless the lamps are removed from the sockets and washed, and of course they are seldom put through that treatment. We have been using incandescent lights, 20 candle power, for nearly fifteen years, and so far as cost and illumination go, we prefer gas. We have long wanted to use the arc lamp, but its intense light and deep shadow has seemed to forbid its use in posted rooms, or rooms having much shafting and belting. Now that we can light by reflection, so that there are absolutely no shadows, the arc being invisible, while a soft mellow light reflected from a white ceiling is evenly diffused, we think we have found the ideal system for mill lighting. In the form we are at present using the light, there is some criticism from insurance men about danger from sparks, but we think changes can be made to cover that point, and with this modification we believe it is the best light yet invented for mill and store purposes.

Now, when I tell a man who has not seen this method of lighting that it produces a far better illumination for much less money than lighting by incandescent lamps, or by gas, he is inclined to doubt my statement, and probably says to himself that I am mistaken, and that it is impossible to produce more illumination for less money, when we twice reflect the light, once from a reflector and again from the ceiling. I admit that this line of argument is plausible, and it may be that an arc light behind a plain glass globe loses a certain per cent. of efficiency, behind a ground glass globe a certain per cent. more, and it may be that with a reflector 50 to 75 per cent. of the light is theoretically lost. All this may be true, I don't know; but what I do know is,

that you can see more and better by a reflected light than by an open light. The human eye is the final test, and not mathematical instruments, and one needs only to see the reflected lighting to appreciate it and be convinced. My theory is, that the open light causes the pupil of the eye to contract, while the hidden light allows the pupil to expand, thus enabling the eye to see more, with the same or less quantity of actual light.

But enough regarding the character and quality of inverted arc lighting. What you and many others want to know is, whether it really costs less than other forms of lighting. This question we are able to answer in the affirmative, and I submit the following comparative tests made in the month of January last. The braiding room, in which the first test was made, is 136 feet long, 66 feet wide, and 12 feet high. There are two rows of posts, a main shaft running about half the length of the room, and three short counter-shafts about the centre of the room. The machinery consists of 420 braiding machines, distributed in 14 rows of 30 machines each. The room was formerly lighted by 84 gas jets. It is now better lighted by 8 inverted arc lamps, placed in two rows, each row 17 feet from the side walls. The lamps are run two in series on the continuous current system, 110 volts, each pair of lamps taking 9 amperes of current. The test (2½ hours each evening) resulted as follows:

The first evening 84 gas jets consumed 1,890 ft. at $1.50 per M	$2.83
The next evening 8 arcs consumed 9,900 watts at 15 cents per M	1.48
Difference	$1.35

or a saving of 47 per cent.

A similar test was made in our worsted spinning room, which is of the same dimensions, and contains 24 English spinning frames, 12 twisters, and 3 spooling machines. This room was considered a difficult one to light, as the frames are high, and the alleys narrow. The room was formerly lighted by 82 gas jets distributed so as to give the light where most needed. It is now better lighted by 10 inverted arcs. The result of this test was as follows:

The first evening 82 gas jets consumed 1,845 ft. at $1.50 per M	$2.79
The next evening 10 arcs consumed 12,373 watts at 15 cents per M	1.86
Difference	$ .93

or a saving of 33⅓ per cent.

In these tests the price for gas is the price we pay to the Pawtucket Gas Company. The price for electricity allows us a good profit for the making of it with our own plant. It is one-tenth of the price for gas per 1,000 feet, and this, Mr. Haskins of your meter department says, is a fair basis on which to fix a price for selling electricity for lighting.

POWER TRANSMISSION.

WATER POWER DEVELOPMENT AT THE GREAT FALLS OF THE POTOMAC.[1]

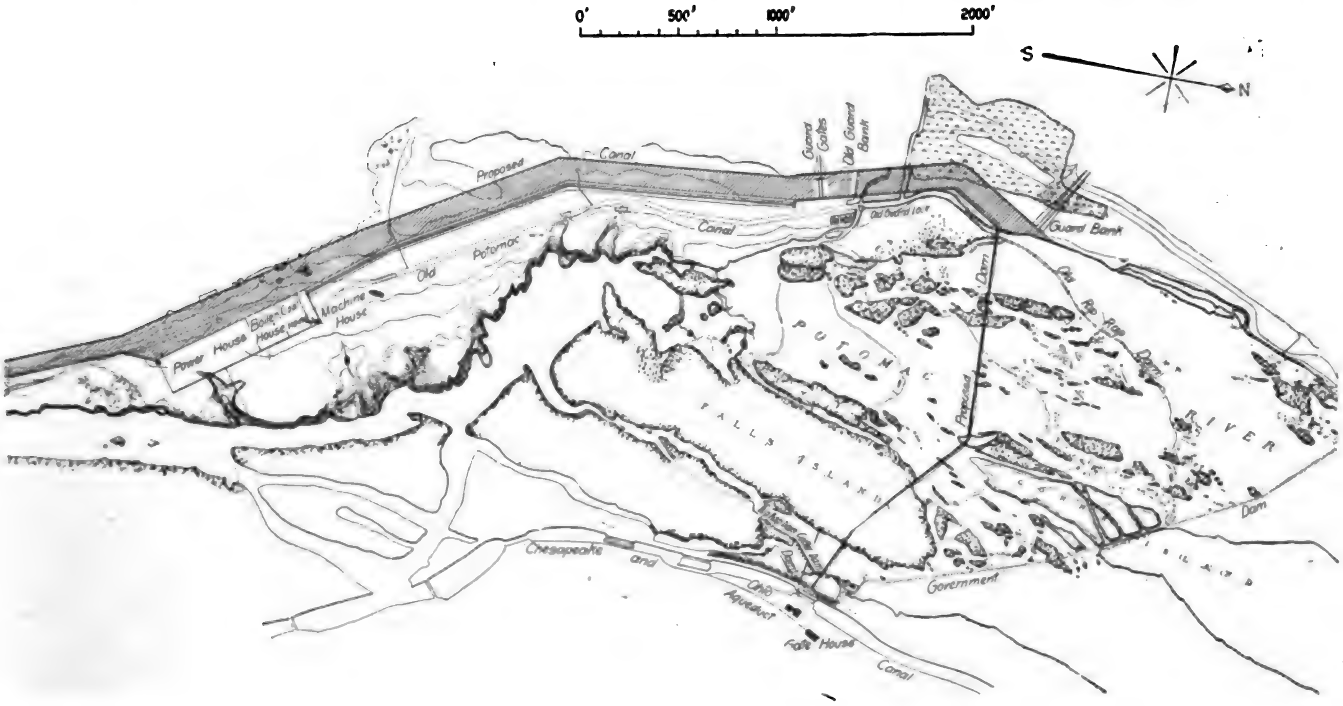
THE Great Falls of the Potomac River are about 15 miles above the city of Washington, D. C. At this point the river is nearly half a mile wide. About one mile further upstream is the dam across the Potomac, built by the U. S. Engineers, for diverting water into the aqueduct supplying Washington. The crest of this dam is about 149 ft. above tide at the Washington Navy Yard, and the total fall to smooth water in time of low water in the river is 80 ft. Above the falls the river has a width of 2,500 ft., and below it flows in a narrow, deep gorge, with nearly vertical walls of gneiss rock, about 60 ft. high, and a general width of about 200 ft. at low water for a distance of about two miles.

The power to be derived from the water not used for the Washington supply is now to be utilized by the Great Falls Power Co., incorporated under a Virginia charter on March 3, 1894.

The river water is already used to some extent by the Chesapeake & Ohio Canal; but Mr. Jos. P. Frizell, the chief engineer, computes that the demand from this source only amounts to 8 cu. ft. per second for the entire day, and he regards 15 cu. ft. as an exceedingly liberal allowance for the canal. The Washington Aqueduct consumes more water, and it is calculated that with the present height of dam it is possible to draw through the aqueduct 120 cu. ft. per second, or nearly 78,000,000 gallons per day. Should the dam be raised, as is contemplated, high enough to fill the aqueduct to the crown of the arch, the draft might be increased to 153⅓ cu. ft. per second, or nearly 100,000,000 per day. This last-named quantity, with a fall of 80 ft., would represent 1,091 H. P.

Mr. Frizell estimates that the company can develop a water power here to the extent of 1,500 cu. ft. per second, or 10,000 H. P., with very little chance of interruption. But he proposes to adopt the works for the consumption of 5,000 cu. ft. per second, or the equivalent of 35,000 H. P. This quantity can be relied upon for nine months in the year, and for the other three months he would supplement the water by steam power. In fact, gage readings for the years 1886-1893, inclusive, show that except on an average of 106 days in the year, 7,500 cu. ft. per second are available, or the equivalent of 50,000 H. P. This 106 days represents the time in each year in which steam power would have to be used in the development of 50,000 H. P.

The Great Falls Manufacturing Co. owns the Virginia shore of the Potomac from a point near the dam 2½ miles downstream, and including 876 acres on that side. It also owns Conn's Island, and has joint rights with the United States in Falls Island and the Maryland shore. The building of the government dam has also diverted water from the Virginia to the Maryland side of the



MAP SHOWING WATER POWER DEVELOPMENT AT THE GREAT FALLS OF THE POTOMAC.

1. Abstract from the *Engineering News*.

river, without deriving any especial benefit from this diversion. As the company then owned and still owns Conn's Island, it claims that this diversion is an injury, and negotiations are in progress for an adjustment of the matter.

The works proposed by the company include a dam and gate and power houses, with all equipment necessary. It is proposed to raise the government dam 3 ft., which would back up the water about two miles and provide in this 3 ft. of extra depth a pondage of about 600,000,000 cu. ft., or a flow of 2,000 cu. ft. per second for a little over eight hours. As this drawing down of the lake above the dam would probably not be satisfactory to the United States authorities, the present plan contemplates a new dam, which would hold the water at not less than 3 ft. nor more than 6 ft. above the present dam. This would back the water up about 3 miles, and give a pondage sufficient to hold 5.000 cu. ft. per second for five or six hours. Pondage is of vital importance in such an enterprise on account of the varying demand for power at different hours of the day. The fall would be 82 to 83 ft.; on which, with wheels of ordinary construction, 1 cu. ft. per second amounts to fully 7 H. P. This dam would be built of dressed stone on the downstream face and cap, and be raised 3 ft. above the present dam, with 3 ft. flashboards above that. These boards would be supported by iron pins let into holes in the cap-stones, with the idea that in heavy floods, or under the action of ice and driftwood, the pins would bend and allow the boards to be carried away. The form of the dam is similar to that on the Merrimac at Lowell. The length of the dam proper would be about 2,600 ft., with a continuation of the canal wall for 800 ft. more, and considerable earth embankment.

The power station is planned with the especial purpose of supplying Washington and Baltimore with electric current for lighting purposes and for operating the electric railways of Washington. Mr. Frizell estimates this demand as equal to 8,600 H. P. for Washington and 7,200 H. P. for Baltimore, requiring the establishment of a power plant at Great Falls, capable of utilizing 12,000 H. P. for the one city and 10,000 H. P. for the other, or 22,000 H. P. in all. This plant would call for 1,420 cu. ft. of water per second, which he believes can be depended upon for all time.

The power house would be 500 ft. long, with two raceways along the centre cut to a depth of 16 ft. below low-water level. The wheels will run on horizontal axles, for the greater simplicity of driving connections. The generators will be arranged in pairs, with two 500-K.-W. generators on each shaft, though two or more shafts may be connected when desired. Each shaft has three pulleys—two at the ends for driving from the wheels, and one in the center, to be driven by a steam engine when steam may be required. Each water-wheel would have a capacity of 1,500 H. P., and 16 wheels are included in the estimate, with room for several more.

Mr. Frizell's report gives the estimate of cost in detail, but this may be summarized as follows:

Dam	$150,000
Gate house	50,000
Canal	127,000
Power house, wheels and races	522,000
Electric plant	1,567,600
Administration and engineering, 5 per cent	120,880
Total	$2,537,480

The annual revenue expected from Washington is $297,250 and from Baltimore, $440,000; a total of $737,250. The annual charge for maintenance, depreciation and taxes is figured at $234,170, leaving a probable net income of $503,079.

SIZING UP THE ROSY PROJECT FOR ELECTRIC POWER, AT LEE, MASS.

Discussing the Lee project mentioned in a recent issue of The Electrical Engineer, Mr. F. L. Pope writes: "In these latter days, a great many schemes are brought forward involving the industrial application of electricity which are of doubtful merit; that is to say, they 'cost more than they come to,' as we say in New England. It appears to me that the project mentioned in local journals a few days since, in reference to supplying the manufacturers of Lee with power from Goose pond or Lake May, is one of this kind. I have before me a published statement in which it is asserted that a computation based on the record of the past two exceptionally dry years proves that 'there is not the slightest question that the supply of water would be ample for the scheme as outlined,' and that it is sufficient to furnish 'at a very low estimate, 2,000 horse power night and day during the entire year.' Upon the basis that it costs $40 to produce a horse power by steam in Lee, which is not an unreasonable figure, it is assumed that $80,000 worth of power a year can be delivered within a radius of 10 miles of Lee village at an annual cost, inclusive of interest, depreciation and operating expenses, not to exceed $10,000. These are very attractive figures, but I fear they will not bear critical investigation.

"Goose pond lies in a high valley among the mountains between Tyringham and Lee. Including Long pond, which connects with it, it has an area of about 325 acres. The area of watershed, exclusive of the lakes, does not exceed four square miles. Assuming it to be practicable to confine the waters of the lake so that none will be wasted by overflow in the spring, and that in accordance with the usual assumption in such cases, the rain falling directly into the lake is sufficient to compensate for evaporation and leakage, it is not difficult to compute approximately the quantity of water available. The mean rainfall in Berkshire is about 37.5 inches per annum; in a dry year about 80 per cent of this, or 30 inches. Not more than 75 per cent. of this ever gets into the lake; the rest is retained in the porous soil on the wooded slopes and ultimately passes off in evaporation. This leaves 22.5 inches, or 1.87 feet, which falling upon four square miles of water shed would yield, in round numbers, 198,500,000 cubic feet of water to draw from in a dry year, equal to 337 cubic feet per minute. The plan contemplates a steel pipe about 16,000 feet long, which, it is stated, will give a head of 600 feet. This pipe ought to be about 20 inches in diameter, and in such case the loss of head by friction would be approximately 24 feet, leaving a net head of say 576 feet; 377 cubic feet of water per minute will yield a gross horse-power of .71 for each foot of available head, or 409 horse power in all. Assuming 80 per cent. efficiency for the water wheel, 90 per cent. for the electric generator and 90 per cent. for the distributing system there remains only 262 horse-power available for industrial purposes. Whether it is worth while to expend $50,000 or $60,000 to secure this amount of power is a question which which can best be answered by those interested. No doubt there are cases in which it would pay well to do it, but I should hardly think it likely in the present instance."

GENERATION AND DISTRIBUTION OF ELECTRIC POWER FOR MANUFACTURING PURPOSES.[1]

BY C. A. STONE AND E. S. WEBSTER.

One of the principal questions of interest to the manufacturer to-day, is whether or not by the adoption of electric devices, in one form or another, he can effect a saving in driving the machinery of his mill.

Many forms of machinery can now be driven directly by electric motors, and recent discoveries in electrical science and improvements in existing types of apparatus will probably before long make it possible to drive nearly all forms of mechanical devices directly by electric power without the use of countershafts.

As illustrating the amount of power consumed in driving the shafting of an ordinary machine shop it will be of interest to refer to the accompanying curve, which shows the total horse power required in driving the machinery of an ordinary stamping mill. To obtain this curve, indicator diagrams were taken at the engine at various intervals throughout the day, and at noon when all the machinery was shut down, excepting the countershafting, a series of cards were taken to determine the actual power required to overcome the friction, which, as can readily be seen from the curve, amounted to more than sixty per cent. of the entire work done. As a matter of fact, the actual average indicated horse power throughout the day was sixty-two and three-tenths, and the average friction load thirty-nine and six-tenths, including engine friction, which amounted to about six horse power. From this it will be seen that in order to furnish about twenty-three horse power to be used in actual work, it was necessary to produce over sixty-two horse power, including engine friction. Of course, no electrical method of driving would save the six horse power lost in the engine, but it is unquestionably true that a very considerable proportion of the remaining thirty-three and six-tenths horse power lost in shafting and belting could be saved by the direct application of motors to the machines themselves. Even allowing that in an electric transmission scheme of this sort, involving the use of small motors, an actual commercial efficiency of only 60 per cent. could be secured, still, we should be obliged to supply only forty-four indicated horse power, assuming the engine losses to be the same. This application of small motors directly to machines has been increasing considerably during the past few years, and there are now a number of manufacturing establishments where they have been introduced extensively.

Motors specially constructed for direct application to different forms of machinery require much thought and attention to build, and at best some experimental work is necessary to secure perfection in operation and control, but there are at least five well defined cases where electric power transmission can always be used to advantage with standard forms of electrical apparatus. These cases may be roughly outlined as follows:

1st. Where a large water power is available at a considerable distance from a mill which is in need of more power than can be obtained from the water privilege at the mill itself.

2d. Where, owing to the separation of mill buildings, it is

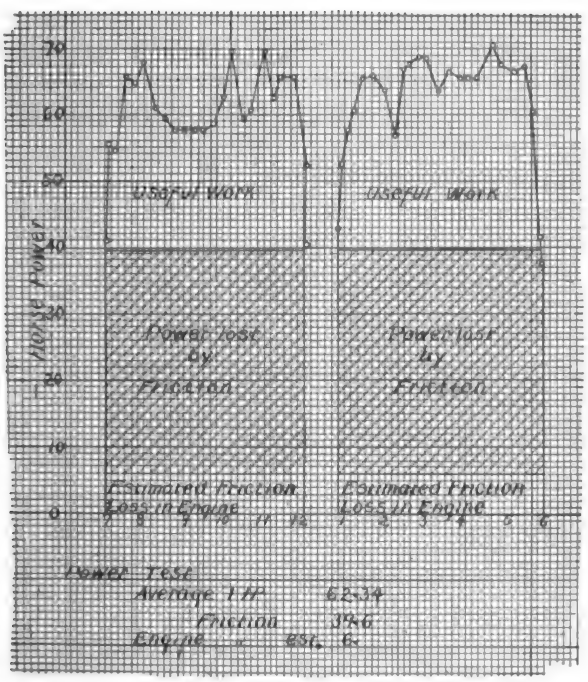
1. Abstract of a paper read before the New England Cotton Manufacturers' Assoc.

desired to transmit power further than can be done by belting, in order to avoid the installation of individual steam plants in each building.

3rd. Where small water privileges are available at various points along a stream, but in order to become useful the power must be concentrated at one point without too great expense for maintenance and operation of the individual parts of the system.

4th. Where for various reasons in selecting a mill site it is desirable to locate at a considerable distance from the source of power, usually on account of the fact that the land immediately adjacent to the privilege is not suitable as a location.

5th. Where, for special reasons, it is important to do away with shafting throughout the mill, and to avoid on account of fire risk or other reasons the ordinary belt holes between floors. That results can readily be accomplished is best demonstrated by the fact that there are in daily operation throughout this country plants which are fulfilling every requirement. Take, for example, the first case which we have outlined, in which a water power is available at a considerable distance from the mill where the power is required. There are, perhaps, fifty plants in regular operation in this country which fall under this head. At least six different systems of transmission are in use for work of this sort, and in places where plants have been properly installed each is giving good results. One of the earliest long-distance transmission plants of this sort which was equipped,



Curves Showing Relation of Useful Work and Friction.

was that built by the Westinghouse Company for the San Miguel Mining Company, at Telluride, Colorado.

Admitting, then, that power can be transmitted satisfactorily, the next important point is the economy of the electric transmission.

To get a general idea of the cost, let us take the case of a water privilege with 1,000 horse power available, situated at a distance of two miles from a mill where this amount of power can be used to advantage. We shall assume that the cost of power ready to be delivered to the dynamos is $12 per annum, including all charges for interest, depreciation, and attendance of the hydraulic part of the system. The commercial efficiency of transmission will not be far from eighty per cent., so that if we are to start with 1,000 horse power we shall not be able to deliver over 800.

The cost of electrical machinery for a plant of this size would amount to about $23,000, and the interest, depreciation, repairs and supplies may be conservatively estimated a $3,500 per annum.

The necessary pole line, wire, accessories, and labor of installation would cost about $13,000, and interest and depreciation on this should be figured at eight per cent., which gives an annual expense of $1,040. One man will be required at either end if a ten-hour run is made, and two men if a twenty-four-hour run is made. In the first case the cost of attendance would amount to $1,200 per annum, and in the second case to $2,400 per annum. On the basis of these figures, which practice has demonstrated are substantially correct, we find that the cost per horse power delivered for the electrical part of the system amounts to $6.80 for a ten-hour run, and $8 for twenty-four-hour run, to which must be added $15 per useful horse power for the cost of the water power, making a total of $21.80 and $23 respectively for ten and twenty-four-hour runs. These figures are unquestionably less than those at which steam power could be furnished, except under extremely favorable conditions.

It often happens that in a manufacturing plant the mill buildings are so far separated that it is impracticable to transmit power by means of shafting or belting, and in such a case it is often desirable to install an electric transmission plant, to avoid the necessity of placing separate steam plants in each building.

In order to see approximately what can be done in a case of this sort, let us suppose that we have two mill buildings situated, say, 1,000 feet apart, and that in one mill we require 500 horse power and in the other mill 100. Under such conditions the ordinary custom would be to install separate steam plants in each mill, but if by generating all the power at one point, instead of at two, we can effect a sufficient saving to more than pay the interest, depreciation, and maintenance for an electric transmission plant, we can clearly effect a saving in total cost of operating.

With coal at $5 per ton, using a compound condensing engine, the extra cost per annum of generating 600 horse power ten hours per day over that of generating 500 horse power, would be about $1,400, whereas the 100 horse power alone could not be produced for less than $30 per horse power per annum or $3,000. We could, therefore, afford to pay $1,600 for interest, depreciation, and maintenance of a suitable electric transmission plant for delivering 100 horse power, without increasing our total annual operating expense. Careful figures show that the interest, depreciation, and maintenance of such a plant would not amount to over $800 per annum, so that this is evidently a case where an electrical transmission plant would effect an $800 saving to its owner.

There are many cases of mill properties, especially in New England, where small water privileges are available, varying in size perhaps from fifty to a hundred horse power or over.

That such properties can be made use of to great advantage has been clearly demonstrated by the successful operation of a small plant which we installed some three years ago for the Samson Cordage Company at Shirley, Massachusetts. This company has a mill requiring some 200 horse power to drive, situated on the Nashua River in Shirley, and as the available water power at the mill site was only about 150 horse power, it was formerly necessary to supplement this by steam in order to obtain power enough to drive the machines. At a distance of about quarter of a mile up stream was another mill, now the property of the Samson Cordage Company, which was originally owned by the Shakers of the Shirley settlement, and operated as a cotton mill, but had some time before fallen into disuse. This mill has a water privilege of from fifty to seventy-five horse power capacity, and it was decided to install an electric transmission plant, with the idea of conveying the power to the cordage mill.

The problem, accordingly, as it was presented to us, was to design and install a plant the dynamo of which should be readily controllable from the motor station, and which should be so arranged that the motor would drive on to the main shaft in parallel with the water wheel at the mill, contributing its portion to the whole amount of power required. A 500 volt system was finally decided upon, and a fifty horse power dynamo and motor installed at either end, with extra field wires leading from the dynamo to the motor station, so that the dynamo itself would be under control at all times of the man in charge at the mill. Further than this, an artificial load was provided which could be thrown in parallel with the motor or used to entirely replace it. With these precautions it has been found that the water wheel and dynamo require very little attention and that practically entire control is obtained from the motor end, where, by an adjustment of the field resistance of the dynamo, the motor can be made to contribute any amount of power to the main shaft from nothing up to full load. Further than this, in case of trouble with the remaining part of the driving system, which might cause an unduly heavy load to be thrown upon the motor and thus injure it, a provision was made for tripping a circuit breaker which cuts out the motor and allows it to come to rest, but at the same time throws in the artificial resistance before mentioned, which brings an equal load upon the dynamo and prevents the racing of the water wheel.

In the case of this plant the only expense for the fifty horse power delivered, is that due to the interest on investment, depreciation, repairs, and maintenance. This amounts to less than $15 per horse power for the power actually delivered, and as steam power under existing conditions would at best cost $40 per horse power, the electric system under the conditions mentioned clearly effects a saving to the owner of $1,250 per annum.

Mr. F. V. Henshaw, E. E., writes: "There is a feature which you have recently introduced into the paper, viz., the Data Sheets, that is of great value. I consider it a most excellent idea."

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CONTENTS.

STANDARDIZING LAMP SOCKETS.

It is a well known fact supported by the detailed figures that have been made public by experts from time to time, that incandescent lamps are now sold at a very small margin of profit. Some makes still command a price above the average, but it may be taken that they are better because more cost is put in their production. Such being the case, it would seem desirable for the interests of manufacturer and consumer alike to wipe out unnecessary elements of expense, especially those not due to any existing conditions of competition or engineering development but a tradition or inheritance from the past.

Foremost among the things to be remedied, it seems to us,—and we know it to be the opinion also of representative manufacturers—is the present discreditable miscellaneity of lamp sockets. There was a time when probably 40 or 50 different kinds of sockets were in use pretty generally; and even to-day United States, Brush-Swan, Mather or Perkins, Schaefer or National, Hawkeye and a few other sockets have to be fitted with lamps whose bases are made specially for them. The three main types, however, are Edison, Thomson-Houston and Westinghouse; and the electrical public has good reason to believe and hope that no new sockets additional to the above will be sprung upon it until the great day when the lamp itself undergoes some radical change.

Of course, the lapse of time will gradually remove from the scene most of the types we have enumerated above, and some one or two types will remain, either a composite form or perhaps originals that have the preeminent merits of cheapness, efficiency and endurance. But we cannot help thinking, in view of the narrow margin of profits on lamps already alluded to, that the reform and standardization might as well begin now. Let us assume, for example, that the field is first narrowed down to the present three leading types, and that all the manufacturers cease making for the odd and older types already far in the minority. That would be a first step by which everyone would be gainers, as the manufacturers would be able to reduce at once on the cost of production and would stop carrying stocks of lamps rarely called for. We say this without any reflection on the quality of the lamps named, and are simply dealing with the conditions as they exist and need betterment as to sockets. The question is simply that of standardizing sockets, as we have already standardized the important item of voltage.

If the choice were narrowed down to three types, it seems natural that a further elimination or reduction would depend upon the cost of the bases of the lamps. We are reliably informed that the Thomson-Houston bases cost $7 or $8 per thousand more than do those for the Westinghouse sockets or the Edison. This being so, it would be an obvious economy to discard that type, or not to use it in any original installations from this time out. It is evident that the day is not far distant when the lamp makers will all agree to charge more for other bases than the Edison and Westinghouse, and the reform might as well begin now. We have understood that the General Electric Co. charges, or charged until recently, 1 cent more for lamps with Thomson-Houston bases; whence it would be inferrable that the General Co. would itself be willing to drop that base.

As between the Edison and Westinghouse bases, we

have ourselves no choice, though many of our readers doubtless have, on grounds of more or less validity, and quite aside from "personal equation" or prejudice. All we wish to do is to suggest that the time has arrived for standardization of sockets, with a concurrent gain to the users, the supply houses and the manufacturers. The question is not merely a commercial one, but broadens out into other economies by means of which the electric lighting industry is put on a more scientific basis, and becomes better fitted to hold its own in the wonderful advances that are now going on in the art of illumination.

THE CANADIAN ELECTRICAL CONVENTION.

We publish elsewhere a report of the proceedings last week of the Canadian Electrical Association at its fifth annual meeting. It is a useful body, combining in itself functions that in this country and in England and Germany are divided up among two or three societies. Canadians are certainly to be congratulated upon their activity in electrical manufacture and the developement of local lighting, power and railway enterprises.

In the course of an address, Mr. George Johnston, Government statistician, informed the delegates that he had found out that in Canada to-day there were twenty-seven million dollars' worth of material employed in electric railways and kindred applications. Of electric railways there were 368 miles in Canada, and in all Europe there were only 434 miles. They were ahead of Germany, France and England in this respect. During the past year the trolleys in Canada carried fifty-seven million people, while the steam railways only carried fourteen million. These are really remarkable figures, and show that our Canadian electrical brethren keep well abreast of the times.

ALTERNATING CURRENT ELECTRIC RAILWAYS.

In commenting in our last issue on the mistaken idea prevalent in some quarters that the successful electric locomotive constituted a problem the solution of which depended upon some heaven-born genius, or several of 'em, we pointed out that electric railroading had now entered the stage of evolution and that the demands of the times would be met by the application of methods found to be best adapted to each individual case. We are again convinced of this by the announcement just made that the Allentown & Reading Electric Railway Co., propose to build roads in Schuylkill, Berks and adjoining counties in Pennsylvania and to operate the system with the alternating current including the motors on the cars. If the announcement be quite correct, we cannot say that we are surprised at it. Rumors have long been rife regarding the successful experimental application of the alternating motor on electric cars, but this is the first instance in which is mooted their practical application to everyday traction work in this country. After all, the adoption of the alternating current for this class of work will be but a natural result of recent experience. An electric railway system is an electric transmission system, pure and simple, and when it comes to covering distances of twenty miles, as is the case in the present instance, the prudent engineer is bound to consider every method which will conduce to economy of operation. At the prevailing 500 volts for the continuous current railway service, the cost of feeders for such an extended system must evidently involve a heavy outlay; and with traffic probably not nearly so heavy as can be counted on with roads running entirely within city limits over their entire length the alternating current presents unquestioned advantages as a distributer. Lacking further details as to the proposed methods to be adopted, it would be premature to discuss the régime which would follow the introduction of the alternating motor on railways, but it can be safely said that a successful practical demonstration on the new Pennsylvania road would be followed by the general adoption of the system for interurban and suburban work.

We opine, however, that for ordinary city railway work, the alternating electric railway will be somewhat slow in making progress, if for no other reason than that the large majority of cities in which an electric railway would pay are already provided with the continuous current railway. Then again unless single phase motors be employed on the cars, it will be necessary to have at least two trolley wires, a method which most companies will be likely to shrink from. Our impression is that the new road will still have direct current motors on its cars.

WATER OR CULM?

The description of the new station of the Wilkes-Barre Electric Light Co., by Mr. J. H. Vail, appearing elsewhere in this issue, aside from its special engineering features claims more than passing attention, as it again brings forward a mooted point in cheap power generation and transmission. It has been suggested by more than one competent engineer that the enormous culm piles of Pennsylvania offer a store of energy which can be applied to power generating purposes as cheaply, if not more so, than most water powers, considering their cost of development. As Mr. Vail points out, calculation shows that with fuel so cheap it did not even pay to put in the most approved fuel economizing apparatus. It ought to be no difficult matter to calculate the cost of power, and this has indeed been done at the instance of the Board of Trade of Scranton, who have shown that with culm at 25 cents per ton delivered at the furnace door, a horse power can be generated for $5.93 per annum. These figures are considerably lower than some we have seen mentioned in connection with the Niagara plant, and hence sufficiently inviting, it would seem, to attract power consumers and power transmitters. We have seen no reliable figures as to the cost of transmitting power from the Scranton coal district over long distances, such as to New York or Philadelphia for example, but taking as a basis the calculations of Profs. Houston and Kennelly and applying them to the present case it would seem that New York is not beyond the limits of economical power transmission with Scranton as the source of power; while the intervening territory offers numerous points for the disposal of power at, of course, lower rates. How soon the Pennsylvania culm piles will be utilized will depend much upon the course of events at Niagara. It will probably be only a short time before Niagara's power will be delivered in Buffalo, the long delayed negotiations with this end in view being now brought to a satisfactory conclusion; while on the other hand the experiments in driving canal boats electrically on the Erie Canal will be prosecuted vigorously with current also originating at Niagara. Success at these points will without doubt stimulate and encourage capital to like efforts in other localities; and the Pennsylvania coal districts are sure to be seriously considered. Whether the prime mover is to be a steam or a gas engine, will also come up for consideration, but if some of the figures we have published are reliable it is more than likely that the gas engine will be the one selected in several cases.

ELECTRIC TRANSPORTATION DEPARTMENT.

THIRTEENTH ANNUAL MEETING OF THE NEW YORK STATE STREET RAILWAY ASSOCIATION.

The Thirteenth Annual Meeting of the Street Railway Association of the State of New York was held at the rooms of the Young Men's Christian Association, Albany, N. Y., Tuesday, September 17, 1895, at 10:30 a. m. President G. Tracy Rogers called the meeting to order.

Mr. J. P. F. Clark, of Binghamton, was elected temporary secretary. The roll was called, and the following gentlemen responded as representatives of street railway companies: Allen, C. L., Civil Engineer, Syracuse St. Ry. Co., Syracuse; Charles J. Bissell, Counsel, Rochester Ry. Co., Rochester; Cahoon, J. B., Supt. Elmira and Horseheads Ry. Co., Elmira; Cole, W. W., Supt. Elmira St. Ry, Co., Elmira; Clark, J. P. E., Gen. Man'r., Binghamton St. Ry. Co., Binghamton; Cleminshaw, Charles, Pres., Troy City Railway Co., Troy; Cooper, H. S., Supt. Schenectady St. Ry. Co., Schenectady; Everts, F. L., Supt. Utica & Mowhawk Co., Utica, N. Y.; Frick, Benjamin, Sec. and Treas., Atlantic Ave. R. R. Co., Brooklyn: Havens, William E., Supt. Fishkill St. Ry. Co., Fishkill; McKeever, R. T., Supt. Johnstown St. Ry. Co., Johnstown; McNamara, John W., Treas., Albany Ry., Albany; Meikleham, T. M. R., Supt., B., C. Q. & S. Ry. Co., Brooklyn; Morgan, Godfrey, Manager, Amsterdam St. Ry., Amsterdam; Norton, Benjamin, Pres., Newburg Ry. Co., Newburg; Newton, H. S., Elec. Eng., Syracuse St. Ry., Syracuse; Rogers, G. Tracy, Pres., Binghamton St. Ry. Co., Binghamton; Rusling, F. O., Supt. Buffalo Ry. Co., Buffalo; Smith, Charles H., Supt. Troy City Ry., Troy; Stedman, J. H., Transfer Dept., Rochester Ry. Co., Rochester; Story, C. B., Sec. Hoosick Falls St. Ry. Co., Hoosick Falls; Vickers, Albert, Elec., Syracuse Cons. St. Ry. Co., Syracuse; Wardwell, John S., President, Rome City St. Ry. Co., Rome.

The report of the Executive Committee showed good work in the repression of obnoxious legislation.

The treasurer's report showed receipts of $7,286 and expenses of $6,299, leaving a balance of $986.

President Rogers delivered an admirable address reviewing the progress of the year, and making intelligent comment on the situation. He said, among other pertinent things :—

"The result of the year's experience shows a demand for better road beds and overhead construction, heavier rails, more ties, better ballasting, lighter motors, better machines, and more conservative financiering."

"We now have in this State about fourteen hundred miles of track and an investment of upwards of two hundred millions of dollars. We carry every year seven times the population of the entire United States and over one-third the population of the entire world—over five hundred millions of passengers annually —while the steam roads carry but one hundred and sixty millions. The gross receipts of this street railroad traffic are about twenty-five millions of dollars."

"Over-capitalization, which has been prevalent in years past, is gradually disappearing by reason of foreclosure of mortgages and a general desire for conservatism on the part of financial people interested. In a growing city, with a sound franchise, reasonable capitalization, and a well installed system for which too much has not been paid, the securities should and do commend themselves to the conservative investor."

"The fields which are rapidly opening and which invite our attention are numerous and I shall call your attention to but a few. The United States Government is asking us to carry its mails; society has popularized us with her trolley parties; the Express Companies are negotiating with us to handle their freight; the merchants wish us to carry their goods, the farmer his milk and farm produce; and we are asked to arrange for funeral trains to the cemeteries. We are to-day closer to the public than ever before. Many, if not all of us, have learned to appreciate the fact that the public is not to be beaten and that we must conform to their wishes. The manager who meets with fairness and justice the demands of the public, and who trains his help to be gentlemaniy and courteous to all, not only increases the receipts, but makes friends for his road of the riding public, the city officials and the press. I claim that the best fender on the front of our cars is a clear-headed, careful man of good judgment to handle the brake and motor."

"Competition and recent inventions have leveled the price of nearly all electrical apparatus and supplies to a commercial trade basis. Many of us can repair and in most cases replace a large percentage of our equipment in our own complete machine shops."

"The present demand is for a lighter motor and a flexible suspension of the motor to avoid pounding of the joints. I believe this can be obtained and am pleased to learn that some of the companies are working in this direction. There is still work for the inventor. The extension of our roads into the country and the connection of a number of roads to form a large system brings up the question of potential and feeders. We may look for some valuable experiments in the use of the alternating current on street railway lines. This, in my opinion, is one of the most, if not the most, important and interesting subject that confronts us at the present time."

"Many attempts have been made to produce power from compressed air, acids, and numerous other agencies, but as yet none have been able to compete with electricity in economy and efficiency. However, we are ready to accept any innovation the ever-busy inventor may produce by which we can reduce the cost of operation."

A paper was read by Mr. W. W. Cole, entitled: "Are we laying too many miles of track to reach a few people?,"

Mr. H. S. Newton presented a paper on "Economical Equipment and Operation of Power House."

Mr. Benjamin Norton read a paper entitled: "Is a freight or mail service profitable or unprofitable on Street Railways?"

Mr. J. F. McElroy read a paper on "Car Heating By Electricity."

Mr. C. Loomis Allen read a paper on "General Track Construction."

Mr. J. H. Barnard read a paper on "Signals on Electric Railroads."

There was an animated discussion on the subject of the admission of supplymen as associate members, in which a number of representatives of supply houses participated, opposing the idea, on the ground that it would not tend to the welfare of the Association. The matter came up in the form of an amendment to the By-Laws, which was not adopted.

Mr. Norton moved a rising vote of thanks to President Rogers for the successful efforts he had made during the year in bringing the Association up to its present high standard.

The motion was unanimously adopted.

A vote of thanks was tendered to Mr. J. P. E. Clark, of Binghamton, for his efficient services as temporary Secretary.

The President appointed Messrs. Norton, Cole and Cooper a committee to nominate officers for the ensuing year.

The attendants at the meeting were photographed in front of the Y. M. C. A. building. In the afternoon they visited the Capitol and other places of interest in the city, and made an excursion to Troy, under the auspices of the Albany Railway.

In the evening there was a banquet at the Hotel Kenmore, which was well attended, and was a very successful affair. At its conclusion three cheers were given for Mr. John W. McNamara, Treasurer of the Albany Railway, for his efforts in the entertainment of the visitors.

An interesting exhibit was made in a room adjoining the meeting hall; and the meeting was unanimously considered the most successful in the history of the Association, both in point of attendance and the interest manifested in the business proceedings.

The following officers were elected for the ensuing year: President, G. Tracy Rogers, Binghamton; First Vice-President, W. W. Cole, Elmira; Second Vice-President, John H. Moffitt, Syracuse; Secretary and Treasurer, Benjamin Frick, Brooklyn; Executive Committee: H. H. Vreeland, New York; John W. McNamara, Albany; Henry M. Watson, Buffalo.

The meeting adjourned to meet in Binghamton on the second Tuesday in September, 1896.

EXHIBIT NOTES.

Mr. C. N. Wood, of Boston, had a neat and effective little exhibit of the excellent specialties of the Nuttall Co. in overhead line material, &c.

The Crouse-Tremaine Carbon Co., of Fostoria, O., were represented by Mr. Crouse himself. He had in his pocket a repeat order for 1,000,000 carbons, a few samples of their excellent motor brushes, and some neat little catalogues.

The Robinson Radial Car was shown by means of a neat model in charge of Mr. Ripley.

Other concerns and supply houses were as follows: Allison, Giles C., St. Louis Register Co., St. Louis; Barnard, J. H., Interior Telephone Co., New York; Barrett, Charles E., Hale & Kilburn Mfg. Co., Philadelphia; Brady, Paul T., Westinghouse Co., Syracuse; Cockey, Marston R., Roebling Sons' Co., New York; Delaney, William H., New York; Dutton, N. S., Doerner & Dutton, Cleveland; Estey, F. A., Nuttall Co., Allegheny; Evans, H. O., Johnson Co., New York; Everts, D. T., Simplex Co., New York; Ewing, G. C., Elec. Specialties, Boston; Fowler, F. H., Bemis Car Box Co., Springfield; Ham, W. F., Johnson Co., New York: Hanna, J. A., McGuire Car Truck, New York; Issertel, H. G., H. W. Johns

Co., New York; Lawless, E. J., American Car Co., St. Louis: Long, E. G., Peckham Motor Truck & Wheel Co., New York; MacDuffie, R. L., Taunton Locomotive Mfg. Co., Taunton; McElroy, J. F., Cons. Car Heating Co., Albany; Medbery, H. J., Overhead Equipment, Mechanicville; Mercur, R. J., New York Car Wheel Co., Buffalo; Morse, George C., Rochester Car Wheel Co., Rochester; Newkirk, H. R., Hoefgen, Moxham & Co., New York; Ostrom, John F., Pennsylvania Steel Co., Philadelphia; Packer, E., St. Louis Register Co., New York; Pugh, D. W. and Pugh, John S., Stephenson Co., New York; Robert, Louis E., Johnson Co., New York; Rose, R. M., Hughes Register Co., New York; Russell, F. D., Rochester Car Wheel Co., Rochester; Sharpe, D. W., Newark, N. J.; Silver, William S., Graduated Car Spring Co., New York; Vosburgh, A. C., New Process Raw Hide Co., Syracuse; Wallace, J. E., Smith & Wallace, Boston; Wardwell, F. S. and Wardwell, V.P., Electric Railway Construction, Danbury; Washburne, Wm. A., Cambria Iron Co., New York; Wood, Charles N., Nuttall Co., Boston; Yates, F. A., Trendley Brake Co., St. Louis.

THE CONSOLIDATED CAR HEATING Co., of Albany, made a most interesting exhibit in connection with the able paper on Car Heating read by their electrician, Mr. McElroy. A circuit tapped from the trolley lines was run into the room and connected to a bank of lamps and heaters by means of the Company's special switches, and the whole modus operandi was clearly shown.

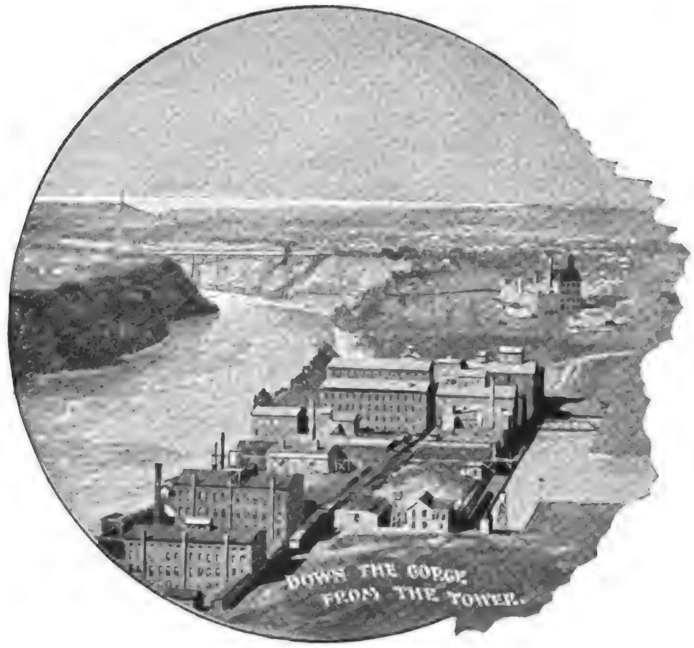
THE NIAGARA GORGE TROLLEY ROAD.

ONE of the boldest and most interesting pieces of electric railway work recently put through is that of the Niagara Falls and Lewiston Railroad, which is already in operation. This piece of engineering, intended chiefly as a competitive American parallel to the trolley road along the Niagara River on the Canadian side,

AROUND GIANT ROCK.

starts in the vicinity of the American Fall, curves down under the railway suspension bridge, fringes the whirlpool rapids and the whirlpool itself, and then follows the littoral, alongside the rushing, roaring stream all the way down to Lewiston. As a route

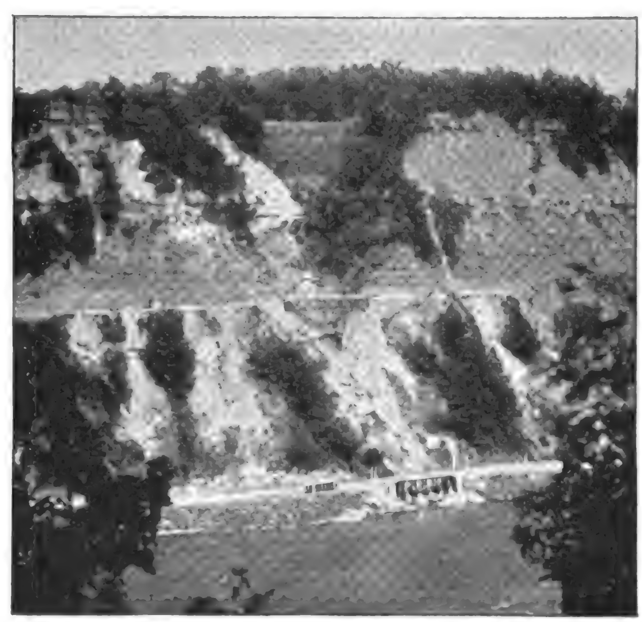
TRACK ALONG RIVER AND RAPIDS.



VIEW SHOWING DESCENT UNDER THE SUSPENSION BRIDGE.

to see the Falls it is also infinitely superior to the old steam line from Niagara to Lewiston, which runs in a few places along the top or on the face of the gorge cliff.

The "Niagara Gorge Road" of which we here furnish a few typical illustrations, was begun on April 28, and went into preliminary operation on July 28. Its present length is a little over 5 miles, but when in full running from the Falls to Lewiston, it will be about 7 miles long. Its equipment consists of 20 cars with Westinghouse motors and controllers, each car having two 50 H. P. motors. The power is furnished from the Schellkopf hydraulic canal, under 210 feet head, to two Westinghouse 500 H. P. generators, which deliver current to the line at 500 volts, the generators being driven by Leffel water wheel. The cars are equipped with Briggs air brakes and have electric heaters. The track is



PARALLELING THE OLD STEAM ROAD—TROLLEY ROAD AT LEVEL OF RIVER.

laid with 60 pound Carnegie rail, and employs H. P. Brown's plastic rail bond. The road is double track with span construction and No. 00 trolley wire is used. Strange as it may seem, the road at present has grades of only 1¼ per cent., although when finished the grades will run up to 8 per cent. The fare for the round trip is 50 cents, which is gladly paid by thousands who thus enjoy at close quarters the thrilling scenery of the whirlpool rapids and the rapids below the debouchure of the whirlpool

Down the rocky gorge, the cars are only a score of feet from the dashing torrent and frequently catch the blinding spray. Moreover, the start is made at the Observation Tower Hotel, where splendid views of the Falls and surrounding country are obtainable.

The Niagara Falls and Lewiston Railroad is capitalized at $1,400,000. The officers are: J. M. Brinker, of Buffalo, president; F. C. M. Lautz, vice-president; R. W. Jones, treasurer; H. P. Bissell, secretary; J. K. Brooks, general superintendent, and G. H. Ricker, chief engineer.

HOW SHALL WE HEAT CARS?—I.[1]

BY J. F. MC ELROY.

I PROPOSE to direct your attention to-day to some of the general principles involved in the construction and operation of electric heaters, and then to present some matters bearing upon the subject of the amount of heat produced and the cost of same.

The general principle employed in the construction of electric heaters is that of placing in these heaters suitable resistances, which resistances become heated by the passage of the electric current.

I believe that the Burton heater was one of the earliest electric heaters tested on the electric railways in this country. In this heater a resisting wire made of German silver was bent in a zigzag form and placed within the hollow space between two iron castings. The wire was embedded in powdered fire clay, and the castings bolted together so as to prevent the loss of fire clay and the disarrangement of the resisting conductor. These two castings which together formed the casing or outside of the heater, contained a roughened surface for the purpose of enlarging the radiating surface of the heater itself. I believe that it was claimed that the embedding of the resisting conductor within a powdered mass of fire clay prevented the air from reaching the conductor and hence prevented its destruction by oxidation when exposed at high temperatures to air.

I think there is no doubt that oxidation in a resisting conductor may be retarded if it is possible to keep the oxygen of the air from reaching the surface of the conductor, but it must be apparent that by such a construction results may be reached which are just as objectionable as the oxidizing of a conductor by contact with air. It is evident that the embedding of a resisting conductor in powdered fire clay or other powdered or pulverulent material which, from its very nature, would be classed as a non-conductor, would retard the escape of heat. The objectionable result is then reached that the temperature of the conductor rises to such a degree that the life of the conducting material is soon destroyed.

Other electric heaters were put upon the market but much difficulty was experienced either from the oxidation of the resisting conductor or from its destruction by fusion when enclosed in a mass of material such as is shown in the Burton heaters.

In considering the conditions which exist in electric heaters and which led to the early destruction of the resisting conductors, we are brought to see that after all the question of building an indestructible heater is comparatively a simple one. An iron wire run at a temperature of 900 or 1,000 degrees Fahrenheit soon becomes oxidized over its surface, and in a short time changes its resistance and finally breaks or separates. This difficulty does not occur at the low temperature of 300 or 400 degrees, but always does occur when metals are run at a temperature of from 900 to 1,200 degrees Fahrenheit.

Another cause of the destruction of resisting conductors lies in their crystallization at high temperature. This is a difficulty to which German silver or any alloy of different metals is especially liable, because the zinc crystallizes at 680 degrees F., its melting point.

Now, it is not necessary in the construction of electric heaters to run near to either danger point which I have just mentioned, that of high temperature or the danger from the use of German silver or other alloys. It is apparent that the temperature above air of the resisting conductor depends upon the amount of heat which that conductor gives out per square foot of its surface, and that the total amount of heat would, therefore, depend upon the number of such units of surface which there may be in the conductor. By multiplying the actual surface by two, we divide the temperature of this conductor above atmospheric air by two and still give out the same amount of heat. This reduction of temperature in the resisting conductor may be carried to any extent desired by simply increasing the amount of actual surface in the resisting conductor to such an extent that the temperature of this conductor will be reduced to a point where the conductor is absolutely safe and its life is permanent. For example: if I find that by using a certain size and length of wire in a car I can obtain sufficient heat in the car by maintaining the wire at 1,200 degrees F. above the temperature of the car, I may obtain the same amount of heat by using four times the amount of wire and then running the temperature of this wire at 300 degrees above the temperature of the car. By adopting the second construction I may entirely obviate the trouble which arises from running the heating conductor at the high temperature of 1,200 degrees above the air. In fact, by enlarging and increasing the amount of actual surface of the conductor itself, we reduce the temperature of the conductor to such a point that no apparent oxidizing effect takes place.

I show you to-day samples of electric heaters with which many of you are already familiar. In these heaters there is such an enlargement of heating surface and this surface is so exposed to the air that the heat may be carried from this surface as fast as generated, and the temperature of the conductor is maintained at such a point that no apparent oxidization results from its use. These heaters are made by the Consolidated Car-Heating Company, and are shown in different forms adapted to the different kinds of construction of cars to which electric heaters are applied.

In the construction of these heaters cylindrical porcelain tubes are threaded upon a ⅜" square iron rod. These tubes are provided on their surface with a spiral groove which runs continuously from end to end. A porcelain disc is placed at each end of the heater, and when desired one is placed at the centre for the purpose of furnishing supports for the binding screws to which the ends of the resisting conductors are attached. We then coil a No. 20 B. & S. galvanized iron wire in the form of a close and continuous coil. As this wire is wound by a machine in the form of a continuous coil just so much of the wire is separated in forming a coil as gives us just the proper resistance. These coils are then placed in the groove which runs spirally around the porcelain insulators. Care is taken to stretch out the coil sufficiently to prevent adjacent spirals of the coil from coming in contact with each other, and contact with that part of the coil in neighboring grooves is prevented by ridges separating the grooves on the porcelain. The result is that this wire is thoroughly insulated and short circuiting within the heater itself is prevented, and still it is wound open so as to present its whole surface to the air. It is so arranged, too, by its even pressure upon the porcelain insulator that no part of this coil can vibrate, and hence there is no danger from the crystallization of the iron wire while hot, from tremor or vibration of the heated wire. This feature of this heater is a very important one as it absolutely prevents the crystallization and hence breaking of the resisting conductor. These coils have now been operated for over three years and not one coil has given out or has shown any oxidizing effect in the substance of the wire. The use of iron as a resisting conductor frees us from the difficulties of crystallization to which German silver is especially liable. The melting point of iron is at a temperature of nearly 3,000 degrees F. so that the temperature of fusion is far above the normal temperature of the resisting conductor, and as vibration of the conductor is prevented by the method of winding it on the insulator, no danger occurs from oxidation, fusion or crystallization.

It is important in the construction of electric heating devices that the expansion of the metallic wire due to change of temperature be fully provided for, and that the heater be so arranged that under no circumstances can the force of expansion and contraction create a strain upon the resisting conductor or upon the insulating parts which would be liable to injure or to break them. This is especially important in conductors designed to be run at a high temperature as the difference in length of the conductors at the extremes of temperature to which it is subjected is quite a considerable part of its length.

Another fact is also to be noted: that the length of a wire which is subjected to heat at intervals and is allowed to cool will gradually shorten, and the contracting force may in certain constructions of heaters cause the breakage of the wire itself.

On the other hand, care must be taken that under no conditions can the expansion of the wire make it loose on the insulator and so cause a short circuit between neighboring wires. The amount of expansion taking place in the amount of wire used in a car equipment of the heaters, which I have shown you, is 7 feet 5 inches; that is to say, the length of wire when heated to the highest temperature to which it is subjected in the regular operation of the heater is 7 feet 5 inches longer than it is when cold. By the construction adopted in this heater it is apparent that this expansion is taken up between consecutive layers of the wire itself so that expansion and contraction of the wires do not operate to vary the tension of the coil of wire, nor even to vary the pressure with which it binds the insulator itself.

The change of temperature in resisting conductors is attended with other phenomena which should be considered in the construction of electric heaters. For example; it is well known that the resistance of a wire of a given material of given length and cross section depends upon the temperature at which the resistance is measured. Iron wire possesses certain qualities in its variation of resistance with temperature which I think admirably fits it for use in electric heaters. (The author then showed diagrams illustrating the change in resistance with change of temperature in iron and German silver wire.) This variable resistance is applied in the construction of electric heaters and the automatic control which this property of iron wire gives us over the temperature of the electric heater itself. It must be clear that if heat is prevented from escaping from an

1. Abstract of a paper read before the Street Railway Assoc., of the State of New York, Albany, Sept. 17, 1895.

electric heater, and the wire does not automatically throttle down a portion of the current passing through it, that it will continue to generate heat and raise the temperature to a dangerous extent. The use of the variable resistance so marked in our iron wire is apparent as its effect is to reduce the amount of current flowing through the heater and hence to reduce the amount of heat generated.

For example, if the temperature rises to 100 degrees Centigrade there would be approximately two-thirds as much current passing through the electric heater with the iron wire as through the electric heater with the German silver. If the thermometer rises to 200 degrees Centigrade the amount of current now passing through the heater with the iron conductor is about one-half of what is passing through the German silver, and hence only about one-half as much heat is generated. If the temperature rises to 300 degrees Centigrade only two-fifths as much current would pass through the iron resisting wire as passes through the German silver. This throttling action of the iron wire increases more rapidly even than the increase of temperature so that at 600 degrees about one-fifth as much current passes through the iron wire as passes through the German silver. This means that the current through the iron wire is reduced in proportion to the fractions which I have just given, and the reduction in current means also a reduction in the amount of heat generated.

A heater, therefore, provided with an iron resisting conductor has this peculiarity over that equipped with German silver, that if for any reason the escape of heat from an electric heater is prevented either purposely or accidentally, the action of the rise of temperature upon the heater itself is to so throttle down the amount of current passing through it and hence the amount of heat generated as to prevent such a high temperature of heat that might prove dangerous. If, for example, we consider the case of two heaters, which we have been comparing, in a car filled with passengers in which there is a partial covering of the discharge openings of the heater by the clothing of the passengers, the action of an accident of this kind on the heater provided with an iron conductor is to stop, in a measure, the flow of current through that heater, so that by the time the temperature of the wire rises to 400 degrees Centigrade three-fourths of the current has been shut off, and hence only one-fourth of the normal amount of heat is generated. This, as a matter of fact, could never occur even were the discharge openings of heaters entirely closed, as the throttling action of the heater itself reduces the current to such a point that comparatively a small rise in temperature would take place due to the fact that part of the heat would find means of escape.

IS A FREIGHT OR MAIL SERVICE PROFITABLE OR UNPROFITABLE ON STREET-RAILWAYS?[1]

BY BENJAMIN NORTON.

Very few companies thus far have branched out into this field, and as I happen to be interested heavily in a line which has gone vigorously into the matter, I can tell briefly our experience and can show you what a successful feature of our business the freight branch of it is; so much so, that we have a regularly organized freight department, waybilling merchandise in regular steam railroad fashion and running regularly scheduled freight trains, all of which pays handsomely.

This line grew out of a tumble-down horse railroad in the city of Newburgh, and after being rebuilt and extended and equipped electrically, we found ourselves tapping the rich Walkill Valley at Walden, twelve miles away, and terminating at the front door of one of the largest cutlery works in this country, running by all the stores and shops in town, and giving an opportunity besides to dairymen of Orange County to get their milk, butter and cheese to boats on the Hudson River at Newburgh inside of an hour, when formerly they had carted it the distance over the rough country roads, the teamsters spending pretty much the day at it and returning home at night, with their mule teams tired out and often a broken down wagon.

This line to day, because it is a short cut in the first place, and because goods can be transported at low rates, in the second place, is handling the dry goods and other merchandise for Walden merchants, shipped from New York to Newburgh by boat; the raw material for the cutlery works in the way of steel, brass, wood and other supplies and bringing back manufactured material, in cases; hay, straw and fruit, and condensed milk in cans from the Borden condensery, only two miles from our terminus at Walden. The road runs along the highway in some portions, and at other points the line is set well back from the roadway on independent property; and the farmers hustle their hay and straw in bales out the side gate to the track and stop the freight car handily, saving (besides 50 cents to $1.00 per ton freight) a long drive to the steam road freight house.

In the month of August the operating cost for handling our freight was a trifle over 40% of the gross receipts. We ran three motor freight cars, carrying from 8 to 12 tons each, and four flat or gondola cars as trailers, carrying from 6 to 8 tons each. At Newburgh the line runs alongside the string piece of the steam boat dock, so that everything can be easily skidded between the boats and cars. We also run close to the Erie and West Shore freight houses and tracks, ensuring an all year round New York connection although as a rule the Ramsdell line of boats is out of service but one month in the year.

Some of our Walden friends remarked the other day that the Walkill Valley Railroad people had soured on the trolley, because their freight trains in both directions were running through Walden without stopping, and they were discussing the notion of discharging their freight agent at that point. I may add that the past week we have hauled from Walden to the Hudson River, among other kinds of freight, about 75 tons of grapes, and the coming week we will do the same. The rate of 18 cents per hundred pounds net to us makes $3.60 a ton, which is a good rate, and requires but one trip per day of a motor freight car and trailer to get it. To earn the same amount of money with passengers would take the entire day and a regular full day crew besides.

The experiments now being made by the N. Y., N. H. & H. Railroad Co. on their Nantasket Beach road are probably not new to you, and it looks very much as though freight business on electric roads would not only be profitable in the near future but generally adopted as a means of revenue by a large percentage of such companies.

As to mail contracts, while the government compensation is comparatively small the actual cost to a company performing the service is so little that they must be profitable to a certain extent; but aside from this no large corporation in a large city where the circumstances call for such a contract should overlook a special safeguard in times of strikes. During my presidency of the Atlantic Avenue Railroad Company in Brooklyn, we undertook to serve the government in this regard and prepared special cars. Part of these cars were devoted to mail matter and mail clerks, and part to regular passengers; so that while they were on the line they were earning money for the company from passengers, the same as other cars, and at the same time the U. S. Mail sign always insured a clear track. Our experience during the strike of last winter proved conclusively the value of a government contract for carrying the mails. The 19 cars on our Fifth avenue line, which, by the contract, were permitted to carry the legend U. S. Mail were not molested, and we were able to keep that particular line open throughout the whole trouble. In view of all the circumstances, I believe a mail contract for a street railway is one of the most profitable things for a small one that it can undertake.

1. Abstract of a paper read before the Street Railway Association of the State of New York, Albany, Sept. 17, 1895.

FROM PROVIDENCE, R. I., TO BUTTONWOODS.

A TROLLEY line from Providence to Buttonwoods, over the Warwick and Oakland Beach branch of the New York, New Haven & Hartford road, is said to be in contemplation by the officials of the Consolidated on the same general plan as the Nantasket Beach road. This action would be taken to mean that the first experiment had proved successful in the judgment of the company and might also be considered to foreshadow the future policy of the company in places situated for traffic similarly to the places named.

ELECTRICITY FOR THE WORCESTER & SHREWSBURY.

The officials of the Worcester and Shrewsbury Railroad Co. Worcester, Mass., have had under consideration for some time a scheme for turning their "Dummy" line between Worcester and Lake Quinsigamond into an electric railway, the cars running from Foster street direct to Lincoln park. This scheme does not contemplate the entire abolition of the steam line, but the addition of another rail, making it possible to run their trolley cars over the system. The tracks are now only three feet wide, and in order to run electrics another rail would have to be built to make the distance 4 feet 8 inches. The company has decided that an electric line could be run much cheaper during the winter than the "Dummy."

Travel during the cold weather is light, and it could be handled easily in the manner proposed at a great reduction. In the summer the steam service could be resumed, and the electrics could be used in special cases. The officials, however, think it might be feasible to continue the electric service entirely, but only a trial can determine.

TROLLEY TUNNEL NEAR NORRISTOWN, PA.

It is expected that the trolley line's tunnel under the Trenton Cut-off on the Germantown pike will be completed by November 15. The tunnel and its approaches are about a thousand feet in length, mostly through limestone rock, and the cost of the improvement, which is paid by the trolley company, is fully $20,000. The trolley tracks will be about 17½ feet below the level of the railroad tracks.

CINCINNATI AND THE UNDERGROUND TROLLEY.

G. M. Gest, who was appointed by the Cincinnati Board of Trade and Transportation to investigate the underground trolley system in use in New York, reports that it is doing satisfactory work, but it has not been tried in bad winter weather and therefore no perfect test has been had.

THE DENVER CABLE SYSTEM SOLD OUT.

The entire plant of the Denver City Cable Company has been sold at public auction to Giles E. Taintor of New York, who represents the reorganization committee appointed by the bondholders. The foreclosure was under the mortages given to the Central Trust Company of New York to secure bonds which now amount, with accrued interest, to a little more than $5,000,000.

Mr. Taintor offered $500,000, the lowest amount permissible under the decree of the court, and after waiting for a time his bid was declared the highest and best. It is now the duty of the special master to report the proceedings to the United States circuit court, and the sale must be approved by Judge Hallett before it is of any binding effect. The road will probably soon be electrified and may then make money.

STUDENTS AS CONDUCTORS IN PHILADELPHIA.

During the past summer between 30 and 40 students of Jefferson Medical College, the Philadelphia College of Dentistry, the University of Pennsylvania and other colleges in this city obtained employment as conductors on the cars of the People's Traction system of Philadelphia. All of the young men came from outside the city, and were working their way through college. The last of them handed in their resignations last week, which the company accepted with regret, for the young men had proved to be the best conductors in its employ. An official of the company said the students were thoroughly honest, intelligent and polite, and as their desire was to earn as much money during the summer as possible they were always willing to work extra hours and take out special cars. They lived economically and have probably saved something like $180 each, which will go a good ways towards paying their college expenses next winter. One of the students has almost concluded not to go back to college, he likes railroading so well, and is still in the employ of the company.

CONTRACT FOR AN INDIANA LINE.

A special dispatch from Goshen, Ind., of Sept. 13, says: A contract for building the Indiana electric railway between Goshen and Elkhart has been signed by the Chicago branch of the White-Crosby Company, of Baltimore, and J. J. Burns, of the Cosmo Buttermilk Soap Company, of Chicago, and president of the company. The contract stipulates that the road shall be completed within ninety days. The line when completed will unite the two electric railway systems at Goshen and Elkhart owned by this company. It will be ten miles long.

STORAGE CARS FOR ANOTHER NEW YORK ROAD—THE ST. NICHOLAS AVE.

The particular storage battery and motor which is to be introduced on the St. Nicholas avenue line, the machinery for which is now lying at the One Hundred and Twenty-fifth street depot, was tried for over a year on the Ninth avenue line, running from Fifty-third street northward. A car was started in September, 1892, and it ran continuously until December, 1893, under the direction of W. M. McDougall, the inventor and engineer, with the exception of two months, when it was taken off for reasons that had nothing to do with its success. The system has been fully described and illustrated in The Electrical Engineer.

Just about the time they were getting ready to equip the Ninth Avenue Railroad with storage battery cars, it was swallowed up by the syndicate, and the new system suffered. Now it is in the hands of John R. Dos Passos, William Steinway and men of that stamp, who are organizing a company under the name of the Metropolitan Electrical Development Company.

MORE TROLLEY FOR NEW YORK CITY.

The North New-York City Traction Company has been incorporated to conduct a street surface railroad in New-York City about twenty and one-half miles in length, to be operated by any motive power other than locomotive steam power. The termini of the road are as follows: Willis Avenue and East One Hundred and Thirty-fourth street, East One Hundred and Forty-ninth street at the Harlem River, Bungay street at the East River or Long Island Sound, Depot Place, High Bridge, at the tracks of the New York Central and Hudson River Railroad Company; Boston Post Road at the Bronx River, Lafayette Avenue at the Bronx River. The capital is $210,000. The directors are Henry Siebert, Frederick H. Benedict, James H. Haslin, William T. Ryan, Thomas L. Hughes, and Edward J. McGoldrick of New York City; John A. Hamilton, U. S. Grant, and C. Tag of Brooklyn.

The Pennsylvania Railroad Co. is trying a smaller and lighter type of steam locomotive and cars for some of its suburban travel, with the object of seeing whether trolley competition cannot be met on some of its divisions in that way.

Legal Notes.

THE RUDD CIRCUIT TESTER PATENT SUSTAINED—WESTERN ELECTRIC CO. VS. BRUSH ELECTRIC CO.

In the suit of the Western Electric Company *vs.* Brush Electric Company on Patent No. 476,317 issued to C. H. Rudd, June 7, 1892, for System of Testing Electric Circuits, a final decree was entered September 19th, by Judge Showalter of the United States Court finding the patent valid, and infringed by the Brush Electric Company.

The patent in question covers a system of locating grounds and other troubles on an electric light circuit which consists in providing an artificial circuit of high resistance at the station and adapted to be connected to a line circuit, the resistance of the artificial circuit being fixed and so apportioned between contact points that the attendant, by means of a testing set, may find the neutral point in the artificial circuit corresponding to the neutral point of the line circuit connected therewith.

News and Notes.

THE NIAGARA-BUFFALO FRANCHISE.

The Niagara Falls Power Co. and the Buffalo City Council have now, it is understood, so far reconciled their differences as to the proposed franchise that terms have been agreed upon, and a franchise will at once be granted. In the main, the reasonable requests of the Company have been granted, and there is now every reason to believe that Niagara power will be delivered in Buffalo during 1896.

THE ATLANTA EXPOSITION.

The Atlanta Exposition, of which details have already been published in The Electrical Engineer, was opened with great eclat last week, the machinery being started by electricity by President Cleveland, from Gray Gables. The electric lighting of the Fair and the Stieringer electric fountain are highly spoken of by the newspapers.

BURTON ELECTRIC FORGING AND SMELTING COMPANIES.

The American Electric Forging Co., capital $1,500,000, has been formed under the laws of New Jersey to operate the Burton patents in the United States. The offices are at 54 Stone street, N. Y.

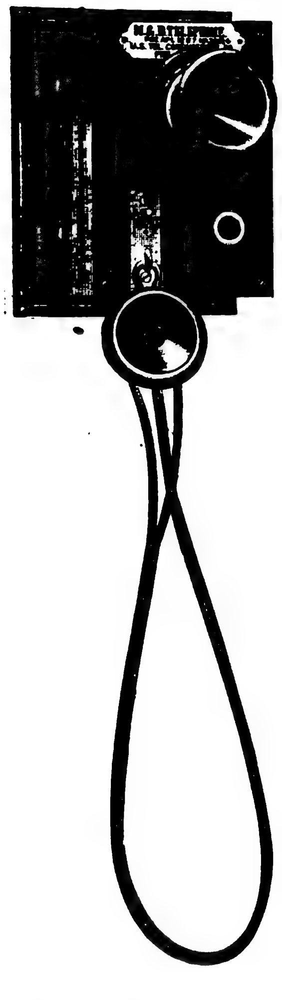
The Burton Electric Co., of San Francisco, is operating the Burton patents in California. It has a capital of $1,000,000.

The Empire State Electric Forging Co., of Syracuse, N. Y., which was incorporated recently with a paid-up capital stock of $300,000, to exploit the Geo. D. Burton liquid system of electric forging and metal heating for the state of New York, held a meeting at the offices of the company, Kirk Building, Syracuse, on the 9th inst. Mr. J. O. Adsit, of Hornellsville, was elected president; Mr. D. E. Mosely, of Rochester, vice-president; Genl. J. A. Reynolds, of Rochester, treasurer; E. D. Woodruff, of Auburn, N. Y., general manager; G. R. Gridley, of Syracuse, secretary. These gentlemen, ex-congressman Baker and Moss Mosely, of Rochester, compose the Board of Directors. This company is organizing local sub-companies at Buffalo, Rochester, Jamestown, Hornellsville, Elmira, Utica, Syracuse and Albany to supply electric forges in the different localities. Very severe tests have been made as to the efficiency of the Burton Electric Forge and it is said that a saving of from 40% to 50% can be made over the coal forge now in use.

The Canadian Electric Forging and Smelting Co., Ltd., with offices at 43 York street, Toronto, has been formed under the laws of the Dominion with a capital stock of $500,000. It has the control of the patents in Canada of Mr. Geo. D. Burton for electric liquid metal heating and forging and the same methods in the treatment of ores. Canada has inexhaustible masses of precious ores that await working in this way. Mr. W. J. Morrison, the well known electrical agent, and lately of Syracuse and New York, is the presiding genius of this new enterprise, which is now being rapidly organized. An exhibit of the forging process, etc., at a recent Toronto exhibition, attracted the utmost attention from men interested in metallurgy.

TELEPHONY.

THE M. & B. TELEPHONE IN THE MANUFACTURERS' CLUB, PHILADELPHIA.



SINCE the United States Telephone Construction Co. have had the M. & B. Telephone on the market they have got out a good many designs and instruments for interior use. The accompanying illustration shows one type known as style "E," which is in use in the Manufacturers' Club, Philadelphia. This club have recently acquired property adjoining their club house and fitted it up with parlors and bachelors' apartments. There are 17 rooms, each of which is supplied with one of these telephones. In the cashier's office down stairs there is a needle annunciator manufactured by the Partrick & Carter Co., to which are added telephone connections and a fire alarm system. In each of the telephones is placed a fire alarm bell.

The telephone measures 4½ by 6½ inches and is 3½ inches deep. It is made of polished oak, finished with a black rubber face and nickel trimmings. All the batteries of this system are in the basement, and are so arranged that any one of the rooms can communicate with the office, or intercommunication can be effected between any points desired. The annunciator is in the hall-way by the cashier's desk, where there is always some one in attendance.

The service given by this arrangement is extremely satisfactory, and combining, as it does, a fire alarm system with the telephone system, makes it doubly valuable. In case fire should be discovered, any employee can go to the annunciator, open a little door in front, and pull out a plug which releases the clock-work mechanism and starts the fire alarm going. This rings all the bells throughout the house, so that the system insures both convenience and safety to the occupants of the club.

BERLINER ON THE NEXT THING IN TELEPHONY.

In a recent interview, Emile Berliner, the telephone inventor, said: "The next step in the development of the telephone will enable a number of persons to talk over the same wire simultaneously, and by this means the cost of long-distance telephoning will be much reduced. Experts are working on this problem now. The Bell Company spends $100,000 a year for experiments. In its Boston laboratory thirty experts are constantly engaged in working on telephone problems. An invention that is even now approaching perfection is the theatrophone. This contrivance will make it possible for people to step into a public office and listen to grand opera, comic opera, or the songs and funny dialogues of a variety show, choosing among such attractions as pleases their fancy. Of course, such a device may be turned to account as a household convenience, so that the well-to-do citizen will be able to listen to a play or opera without leaving his dwelling. Concert music will be on tap in private houses at a cheap rate per month, and one can hear Sousa's Band or the finest vocal performance in the study or drawing room at home by turning the proper switch."

THE LOCAL TELEPHONE TAX AT WICHITA, KAN.

N. G. CHIPCHASE, manager of the Missouri and Kansas Telephone Company's exchange at Wichita, Kan., has been arrested for violating an ordinance making it a misdemeanor to use any telephone instrument in the city not having paid a license tax. The city council recently asked a reduction in the annual toll on telephones, and upon being refused they put on a license tax equal to the amount of the reduction asked. The company failed to pay the tax, and the arrest of Mr. Chipchase is the result.

Suit in habeas corpus has been brought before the Kansas supreme court to test the Wichita telephone ordinance which fixes a license of $2 for business and $10 for residence instruments. The company claims that the ordinance is in violation of the interstate commerce act. It has no wire extending outside of the state from Wichita, but it has a contract with the Western Union Telegraph company, which it says is the same as interstate service, and that therefore the ordinance cannot be made to apply. Chipchase has been released pending a hearing of the case at the October term of the court.

TELEPHONE NOTES.

STANFORD, KY., is to have a telephone exchange.

SALINA, KAN.—The Salina Telephone Company is putting in new telephones and more are expected.

LOOMIS, N. Y.—The telephone line between Loomis and Walton is ready for business.

ST. JOSEPH, MO.—The plant of the Citizens' Telephone Company has been seized for debt.

PORTLAND, ME.—The Telephone Company are building their conduit for wires on Commercial street.

COUDERSPORT, N. Y., is to have an Automatic Exchange Telephone Co. Subscribers will buy their own instruments and the service, it is alleged, will cost but $20 per year.

FORT FAIRFIELD, ME.—Mr. H. L. Cates, superintendent of the White Mountain Telephone Co., states that work will commence on the line to Limestone early in September.

OWENSBORO, KY.—A telephone line will be run from Owensboro to Livermore, in McLean county, and will be connected with all local lines.

GREENWICH, CONN.—The telephone service here has passed into the hands of the Metropolitan Telephone and Telegraph company of New York, the Southern New England's lease having expired on that date.

NEWARK, N. J.—The stockholders of the Newark Mutual Telephone Company have held a meeting and elected Franklin Noble, president; Wallace S. Risley, vice-president, and G. H. Akinson, secretary.

HARMONY GROVE, GA.—Messrs. W. B. Hardman, L. G. Hardman, W. T. Thurmond have applied to the superior court of this county for a charter for a telephone line from here to Athens and also to Jefferson.

ATLANTIC CITY, N. J.—A Mr. Persch is now in the city and is said to be here for the purpose of pushing through council a sweeping ordinance, giving a franchise to a corporation he represents which in turn intends selling it to the National Telephone Company.

ROSE, N. Y.—The construction of the Rose and North Rose lines of the Wayne Telephone Company is now nearing completion. Offices will be established at Rose and North Rose and service between these places and Clyde will commence immediately.

ATLANTIC CITY, N. J.—At an adjourned meeting of City Council, the ordinance granting permission to the Atlantic City Telephone and Telegraph Company to construct a system in this city was passed by a vote of ten to five, and Mayor Stoy at once signed it.

MILLEN, GA.—The Millen and Stillmore Telephone Company, a chartered organization, the president of which is J. D. Overstreet, has built a long distance telephone line from Millen to Stillmore, Ga., along the line of the Millen and Southern railway, a distance of thirty-two miles.

CAMDEN, S. C., is to have a telephone company. The Secretary of State has issued a commission to F. M. Zemp, J. W. Corbett and T. E. Goodale, as incorporators of what is to be known as the Camden Telephone Exchange. The purpose of the company is to erect and operate a telephone system in the city of Camden. The capital stock is $1,000 divided into 100 shares.

DES MOINES, IA.—The Phœnix National Telephone Company has filed articles of incorporation with the county recorder. The capital stock is $1,000,000, and the incorporators Charles M. Waterbury, John W. Paris, Noah J. Clodfelter, Charles A. Meeker, Addison Bybee, Curtis D. Meeker, Gould R. Rhodes, Jacob Frankle, George W. Hadley and M. Smith.

GLENS FALLS, N. Y.—At a meeting of the North Argyle Union Telephone Company the following officers were elected: President, William C. Cuthbert; secretary and treasurer, James K. Henry; directors, Hon. W. D. Stevenson, Rodney VanWormer and A. S. Cuthbert. Arrangements have been made with the Hudson River Telephone Company at Fort Edward so that subscribers will have the use of the Fort Edward, Sandy Hill and Glens Falls switchboards for five cents a switch.

MISCELLANEOUS.

ELECTRIC FURNACES AND THEIR APPLICATION TO THE TRANSFORMATION OF CARBON INTO GRAPHITE.[1]—III.

BY CH. STREET.

In 1888 Mr. Readman took out a patent for a furnace (Fig. 11) intended for the production of phosphorus. The furnace A consisted of refractory material, the heating chamber receiving two electrodes, K, which brought an arc to bear either above or in the vicinity of the material from which the phosphorus was to be extracted. In 1888 M. Reuleaux took out a patent for an electric cupola. This consisted of a piece of circular masonry (Fig. 12), divided at the upper end into three compartments, F F′ F″. These three compartments terminated in a common heating chamber, in which were a series of electrodes, E E′. Tubes C and T allowed of the material being heated before it reached the region of the arc. In 1888 Mr. Crompton patented a mixed furnace (Fig. 13),

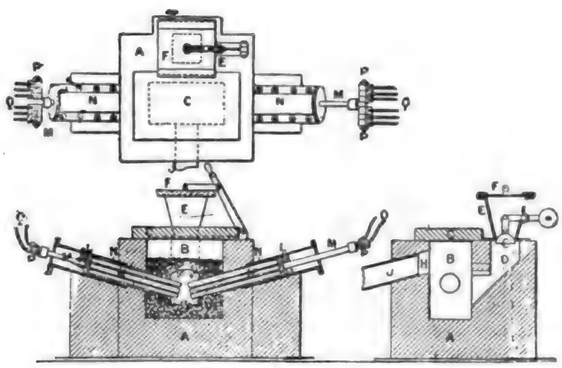


FIG. 11.

in which the heat was produced by electricity and other agents, the material to be treated being brought to a suitable temperature before making use of the electric current; *a a* are the burners, through which the combustible gases were introduced into the interior of the furnace; D and D′ are the electrodes, consisting of a bundle of carbons secured in a holder. In 1889 M. Kiliani patented a device whereby an oscillatory or circular motion was given to the anode with a view to avoid the formation of solid crusts at the surface of the molten bath, crusts which prevent the introduction of fresh matter into the furnace (Fig. 14). In 1889 Mr. Thomas Parker devised the furnace depicted in Fig. 15, in which the heating was due to two rows of electrodes placed opposite each other. At the commencement the electrodes are brought into contact, and the charge is then introduced. The electrodes are next separated and afterwards brought together as fast as they burn away.

In 1890, Mr. Willson patented a device, the object of which was to reduce the consumption of the anode in mixed electric furnaces; that is to say, in furnaces that are calorific as well as electrolytic. To this end the anode (Fig. 16) was a tube of carbon through

FIG. 12.

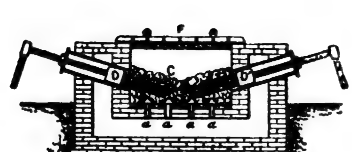
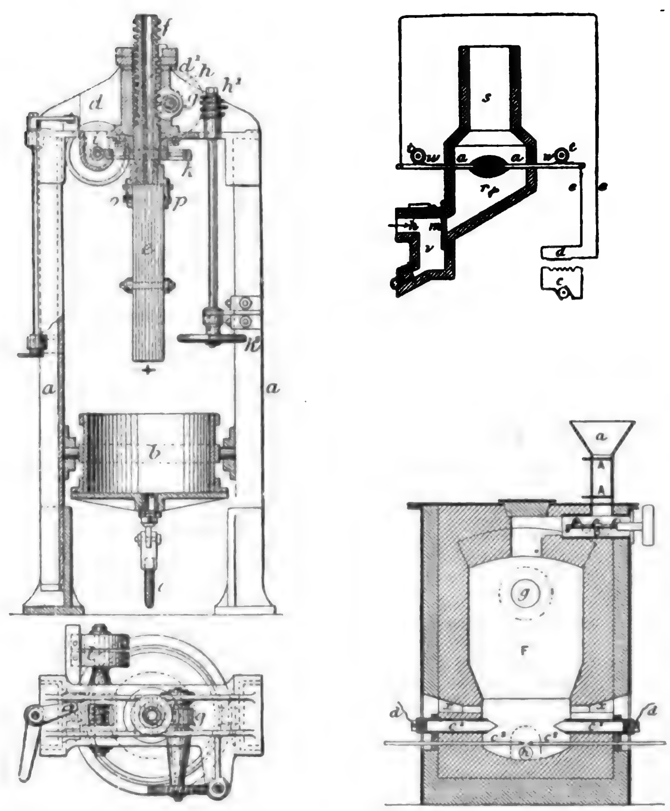


FIG. 13.

which hydrogen, illuminating gas, or some other hydrocarbon gas was passed. This arrangement was used mainly to make aluminum-bronze by means of copper and corundum.

In 1890 Herrn Schneller and Astfalck patented the aluminum furnace shown in Fig. 17. The necessary heat is obtained by means of high voltage currents supplied by secondary generators. The high voltage is employed to overcome the high resistance of the substances to be reduced, and also to take advantage of having a large surface presented to the gases which are to effect the reduction. This reduction is effected by hydrogen or a suitable hydrocarbon introduced into the interior of the furnace. The charge consists either of alumina, or of sulphide, chloride, or fluoride of aluminum. The fall of potential across the furnace terminals is some 20,000 volts.

In 1892 M. de Laval patented a furnace for the fusion of metals. The method employed consists in producing the heat necessary to effect the fusion by passing the current through a layer of molten



FIGS. 14, 15 AND 17.

matter of low conductivity, which is by that means brought to a very high temperature. The current employed is alternating, to avoid electrolytic phenomena. Two arrangements are used, according as the metal is more dense or less dense than the electrolyte. Fig. 18

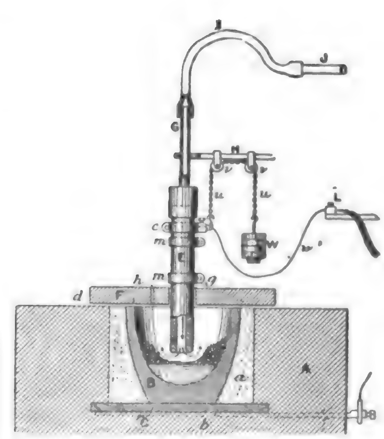


FIG. 16.

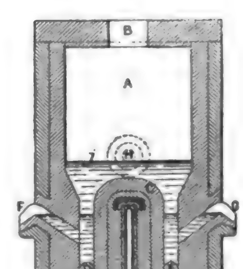


FIG. 18.

shows the apparatus used in the former case. The interior of the furnace is divided throughout its length into two parts by a bridge, C, of refractory material. The electrodes D and E are at the bottom of the furnace, and the circuit is completed by passing over the ridge C through the electrolyte. The metal to be melted is introduced through the opening B, and flows out through the pipes F and G. The excess of electrolyte gets away by the overflow pipe H.

PRACTICAL DATA SHEETS.

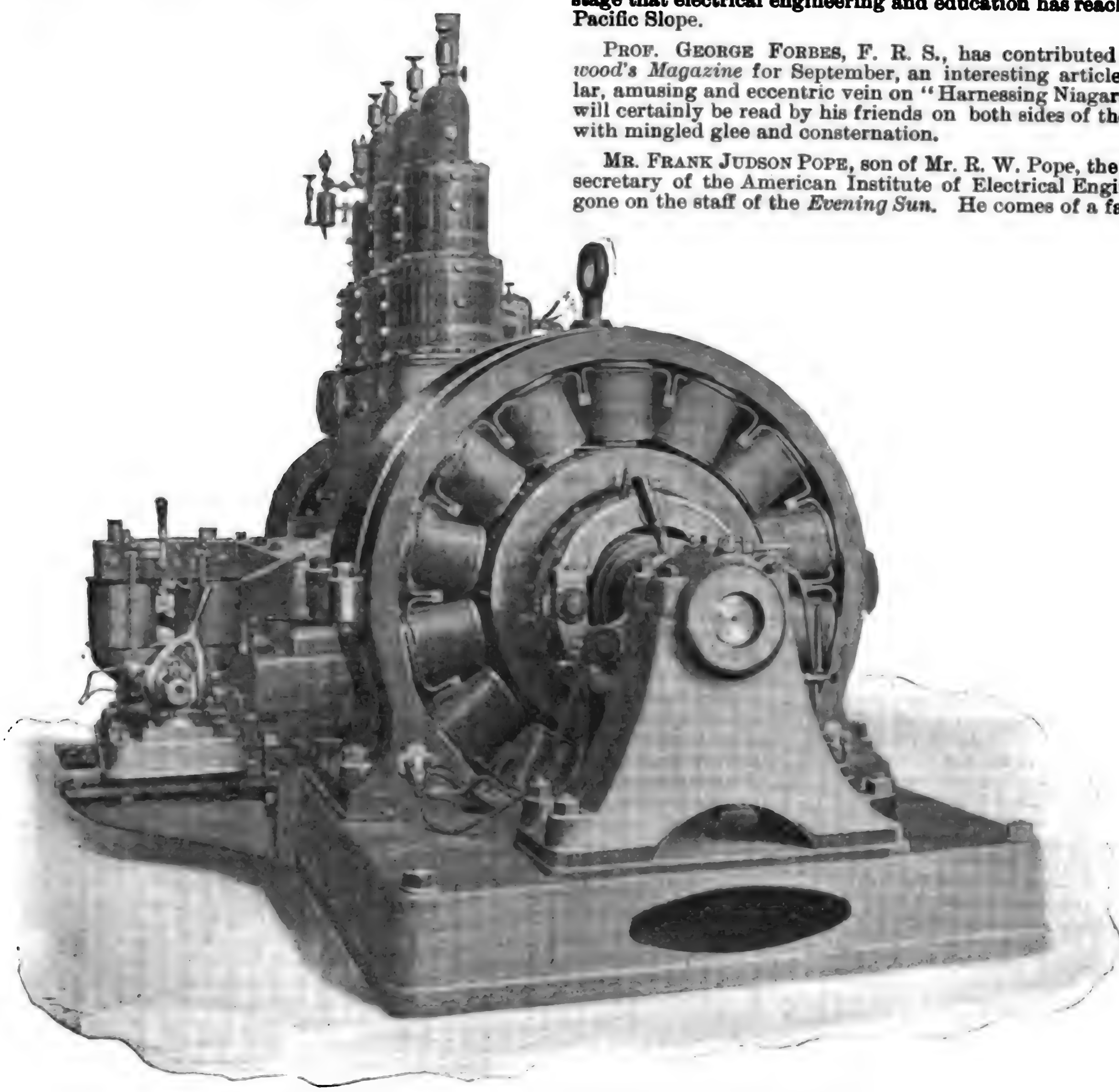
"I THINK the idea is capital, and that the Data Sheets are likely to be very useful, especially if they are confined principally to construction."—HERBERT LAWS WEBB.

COMBINED WILLANS ENGINE AND G. E. MONOCYCLIC GENERATOR.

An interesting combination is the Willans engine and General Electric monocyclic generator illustrated in the accompanying engraving. The engine is of the central valve single acting type of 150 indicated horse power capacity, and the generator is a special monocyclic machine of 140 K. W. capacity. The combination was constructed for the Lake Street Elevated R. R. of Chicago.

The generator embodies all the best features of monocyclic practice. The armature core is built up of insulated laminations, and is provided with ventilating ducts through which the air may be rapidly circulated. The coils are made up separately and, in case of accident, each can be readily removed from the armature without disturbing the other coils. The supplementary coils connected to the power wire are placed in small slots between those occupied by the main coils. The pole pieces are built up of laminations of sheet iron and are cast into the frame of the machine. This eliminates eddy currents in the pole pieces and lowers the magnetic reluctance of the field circuit. The bearings are self-oiling, self-aligning and are designed with ample surface to secure cool running.

Automatic regulation is secured to meet varying conditions of load, by rectifying a portion of the main current and passing it through a supplementary field winding. The generator is designed to give the best results in general distribution and is working without difficulty almost continuously.



Combined Willans Engine and G. E. Monocyclic Generator.

Mr. Allen R. Foote, the economic writer, at one time secretary of the National Electric Light Association, has become editor of the *American Exporter* of this city, the September issue of which bears the impress of his work.

OBITUARY.

Mr. S. P. Kingsbury, of Muskegon, Mich., died on Sept. 12. He was manager of the Western Union office there for seventeen years, and for many years was superintendent of the Muskegon Street Railway.

PERSONAL.

Mr. G. P. Low has decided to call his excellent electrical paper published in San Francisco, *The Journal of Electricity*, under which name he will continue to demonstrate the high stage that electrical engineering and education has reached on the Pacific Slope.

Prof. George Forbes, F. R. S., has contributed to *Blackwood's Magazine* for September, an interesting article, in popular, amusing and eccentric vein on "Harnessing Niagara," which will certainly be read by his friends on both sides of the Atlantic with mingled glee and consternation.

Mr. Frank Judson Pope, son of Mr. R. W. Pope, the estimable secretary of the American Institute of Electrical Engineers, has gone on the staff of the *Evening Sun*. He comes of a family that takes to journalism as naturally as ducks to water, and is well qualified in other respects, having graduated from Columbia College this year.

Mr. W. B. Gill has been elected president of the Philadelphia Local Telegraph Co. in the place of the late Henry Bentley.

Lieut. E. B. Ives, U. S. A., who has been chief engineer of the Electric Traction Co. of Philadelphia for the past 2½ years has resigned, in order to devote his attention to the New Allentown & Reading Railway Co., of which he is chief engineer and a director. He is succeeded in Philadelphia by Mr. A. H. Engstrom, a Swedish engineer, well known in electrical work. He has been chief assistant to Lieut. Ives.

Mr. H. T. Edwards, so long and so well known as the advertising manager of *The Electrical Review*, has joined the forces of the Safety Insulated Wire & Cable Co. of this city, and is now representing them in this territory. Knowing the electrical industry so thoroughly, Mr. Edwards should prove no less useful than he is popular.

SOCIETY AND CLUB NOTES.

FIFTH ANNUAL MEETING OF THE CANADIAN ELECTRICAL ASSOCIATION.

The fifth convention of the Canadian Electrical Association was held at Ottawa on Sept. 18, 19 and 20.

The Convention was formally opened in the Tower room of the House of Commons, when the Mayor read an address of welcome. The President having replied, adjournment took place until the afternoon, when the President, K. J. Dunstan, local Manager of the Bell Telephone Company, Toronto, gave his opening address. "It has been wisely said," he remarked, "that the utilization of energy is a fair test of the progress and civilization of a country, and realizing as we must to what great extent the future industrial progress is bound up with and dependent upon the growth and development of electricity in all its various branches, we, as an association, have the right to feel that in endeavoring to foster and encourage this industry we are working not only in our own interests, but also for the general advancement of the country."

Notable electrical works and improvements during the year were also referred to by President Dunstan. One of the most important electric railways opened for traffic during the past year, said he, was that known as the Hamilton, Grimsby and Beamsville railway, running from the city of Hamilton to Grimsby, a distance of about eighteen miles. It was not only the longest road of the kind in Canada, but was exceptional on account of the large amount of freight which it handled. He was informed that during June, July and August it carried 97,164 passengers and 559 tons of freight in addition to 2,917 cans of milk and a large quantity of fruit. A large fruit market had been established in Hamilton in connection with this railway. The advantages such a road afforded to farmers and fruit growers, and the value to Hamilton in being made the headquarters of the great fruit trade of a large section of the Niagara Peninsula were apparent.

As a result they now found similar electric roads projected or under construction in all parts of the country. These railways, he believed, would go far to break down that isolation which made country life so distasteful to the younger members of the community, and may have a far-reaching effect upon the great problem of how to attach the people to the soil.

In the telephone field the event of most moment had been the opening of the new main exchange belonging to the Bell Telephone Company in Toronto. The switch board was of the most modern type, complete in every detail, and known technically as a branch terminal board. It had all the novel features, including self-restoring drops, incandescent pilot lamps, automatic disconnect signals, etc. This switch was not only a sample of the most modern type of the multiple board, but is the largest installation of the kind in the world. After referring to the defeat of the by-law for municipal control of city lighting in Toronto, President Dunstan continued:

"Last year the Welsbach burner formed a slight unsettling element in the lighting business, there being those who felt that the greater efficiency of the burner would, by cutting down the cost of gas, injuriously affect lighting interests. These fears have proved to a very great extent groundless, but we find this year a new disturbing feature, in the form of acetylene gas, but to what extent it will become a live issue yet remains to be seen, as it is too early to predict the commercial outcome of Mr. Willson's cheapened method of production. The gas has defects which may prevent it ever coming into general use, but on the other hand it is possible it may become an important factor. Whatever the outcome, electric light men must face the fact that prices from competition or other causes, have a downward tendency and this tendency must be met with improved methods of production."

"They must prepare," he continued, "for every eventuality of their business; and their annual conventions, where there was interchange of thought and experience, tended towards the systematizing of methods and towards placing the conduct of business upon a higher, more scientific and more economical plane."

Indications pointed strongly to their being on the verge of a "horseless age"; an age when tricycles, carriages and a large proportion of vehicles in general will be self-propelled. Tests had so far resulted greatly in favor of petroleum, but electricity had so many advantages due to freedom from dirt, smell and risk of explosion that the discovery of a lighter and more economical form of storage battery would enable electricity to control a trade, the magnitude of which it was difficult to even estimate. The person who had made this discovery would reap the greatest reward of the age.

The following were the officers and others in attendance: *President*, K. J. Dunstan; 1*st Vice-President*, A. B. Smith, Inspector Canadian Board Fire Underwriters, Toronto: 2*nd Vice-President*, C. Berkeley Powell, Manager Ottawa Electric Light Co., Ottawa; *Secretary-Treasurer*, C. H. Mortimer, Publisher Electrical News, Toronto. *Executive Committee*, L. B. McFarlane, Bell Telephone Co., Montreal; George Black, G. N. W. Telegraph Company, Hamilton; E. C. Breithaupt, Berlin; D. A. Starr, Electrical Engineer, Montreal; J. J. Wright, Manager Toronto Electric Light Company; J. A. Kammerer, Royal Electric Company, Toronto; J. W. Taylor, Manager Ottawa Porcelain and Carbon Company; O. Higman, Inland Revenue Department, Ottawa.

Montreal—W. T. Bonner, L. B. McFarlane, H. O. Edwards, D. N. McLaren, J. A. Burnett, John Carroll, T. W. Atkinson.

Toronto.—A. M. Wickens, F. C. Armstrong, J. A. Baylis, W. B. Jackson, T. F. Dryden, J. H. F. Wyse, Joseph Wright, Charles P. Dwight, E. B. Biggar, F. C. Maw, J. C. Gardner; *Quebec*—T. A. Bodfery; *Rat Portage, Ont.*—J. A. McCrossam; *Port Hope, Ont.*—U. B. Coleman; *Peterborough, Ont.*—H. O. Fisk, J. S. Knapman; *Aylmer, P. Q.*—J. P. Brown; *Brockville, Ont.*—W. G. Gilmour; *Renfrew, Ont.*—A. A. Wright, C. H. Wright, W. A. Mackay; *Arnprior, Ont.*—R. G. Moles; *New York*—F. W. Harrington, John H. Dale, W. R. McLaughlin; *Ottawa*—John Murphy, H. G. Roche, J. N. Thompson, A. A. Dion, George McDonald, C. Routh, H. Bott, D. C. Dewar, W. Y. Soper, William Borthwick, D. R. Street, F. Journeaux (THE ELECTRICAL ENGINEER).

The annual report of the Secretary-treasurer showed the association to have 69 active and 41 associate members, a gain of 71 during the year. The balance to the credit of the association was $370.54.

The following papers were read and discussed:—The Telegraph in Canada, by C. P. Dwight; A Non-Interference Diplex Relay, by D. H. Keeley; A Percentage Method for Circuit Measurements, by D. H. Keeley; Suggested Forms in Electric Light Accounting, by D. R. Street; Some Modern Alternating Current Apparatus, by H. T. Hartman; From the Coal Pile to the Meter, by James Milne; Some Notes on the Consolidation of Two Systems of Electric Supply, by A. A. Dion.

The following are the new officers of the association:—*President*, A. B. Smith, G. N. W. Telegraph Company, Toronto. *First Vice-President*, C. Berkeley Powell, Ottawa Electric Company, Ottawa. *Second Vice-President*, L. B. Macfarlane, Manager Eastern Department, Bell Telephone Company, Montreal. *Secretary-Treasurer*, C. H. Mortimer, *Electrical News* Toronto, re-elected by acclamation.

Executive, one year: Geo. Black, Hamilton; E. Carl Breithaupt, Berlin; O. Higman, Ottawa; J. J. Wright, Toronto. Two years: F. H. Badger, Quebec; W. Y. Soper, Ottawa; A. M. Wickens, Toronto; K. J. Dunstan, Toronto; John Carroll, Toronto. It was decided that the next convention be held in Toronto in June, instead of October.

MR. A. B. SMITH, of Toronto, the new president of the association, was born in Montreal. He has been identified with telegraphy for thirty years. He is now superintendent of the G. N. W. Telegraph Company in Toronto, and electrical expert of the Canadian Fire Underwriters' Association. Mr. Smith was one of the originators of the Canadian Electrical Association and was raised from first vice-president to the presidency by acclamation. Vice-president C. B. Powell is a son of the Adjutant-General of Canada. Shortly after graduating from McGill College, Montreal, he became mechanical superintendent of the California Southern railway. Later he was master mechanic of the Old Colony road. Subsequently he returned to Ottawa and became a member of the milling firm of Perley & Pattee. When the Standard Electric Company was organized in 1891 he was selected to manage its affairs and on the amalgamation of electric interests at Ottawa last year he was made one of the directors of the new company.

Mr. Chas. H. Mortimer, of Toronto, who is secretary-treasurer of the Association for the fifth time, is one of the best known publishers in Canada. The *Canadian Architect and Builder* and the *Canada Lumberman*, as well as the *Canadian Electrical News*, are issued from his house in Toronto. Being greatly interested in electrical matters he was one of the organizers of the present Association. He was elected secretary-treasurer at the first meeting and has been re-elected by acclamation every year since.

CONVENTION NOTES.

Ottawa was well chosen for the fifth annual convention of the Canadian Electrical Association. Owing to abundant water power in the immediate neighborhood the development of electrical application to light, traffic and manufacturing has been simply wonderful since the introduction of the first plant a few years ago. The local committee were thus able to offer their guest much that interested them professionally as well as socially. The crowning social event of the delegates' Ottawa experience was the magnificent banquet with which they were entertained on Wednesday evening. The large dining-room of the Russell House was made to blaze with incandescent light effects. The mural decorations consisted of electrical representations of national flags, trophies and the like, while the ornamental confections that graced the tables were in keeping with the banquet design, being fashioned to represent dynamos, trolley cars, telegraph and telephone appurtenances. From an arch over each

chair a colored light to shed its rays upon the seated guest. The affair was admittedly the best conceived and most striking demonstration of the decorative possibilities of electric lighting ever seen in the country.

Mr. K. J. Dunstan, retiring president, presided, on his right being Mayor Borthwick and Mr. Joseph Kavanagh, president of the Board of Trade, and on his left Sir James Grant, M. P., and Mr. H. P. Dwight, president of the G. N. W. Telegraph Company. Over one hundred ladies and gentlemen sat down.

TUESDAY EVENING the delegates were conveyed on special electric cars to the Chaudiere and shown the Falls, the sawmills in operation by electric light, and the interior of the electric light and railway power houses. Mr. W. Y. Soper and Mr. C. Berkeley Powell, of the local committee, were in charge of the party, the members of which were greatly delighted with what they saw, and became more than ever convinced that as an electrical centre Ottawa is ahead of any other city in Canada.

During their stay the delegates were also taken for a sail in the Governor-General's electric launch.

NEW YORK ELECTRICAL SOCIETY.

The opening session of the Society will be held at Columbia College on Sept. 27, at 8 P. M., when Mr. T. C. Martin will deliver an illustrated lecture entitled "Niagara on Tap."

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

Mr. C. S. Bradley will read his paper on "Phasing Transformers" at the Hoffman House, on Sept. 25, at 8 P. M., where an exhibit of his apparatus in operation will also be made at the same time. A meeting will be held in Chicago on the same night.

THE NATIONAL SOCIETY OF ELECTRO-THERAPEUTISTS held its third annual convention at Boston last week, when a number of papers were read on points of interest to the medical profession.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED SEPT. 17, 1895.

Alarms and Signals:—

Insulating Railroad Joints for Electrical Signals, T. O'Brien, Jr., Philadelphia, Pa., 546,494. Filed July 18, 1895.
A wooden stringer on which the insulated ends of rails are supported, longitudinally extending wooden blocks aside of the rails, and metallic chairs secured to said blocks and separated from each other, the bases of said chairs being also separated and adapted to be spiked to wooden ties.

Apparatus for Signalling Vehicles by Numbers, F. Warren, New York, 546,409. Filed Jan. 15, 1895.
A sign box in which the numbers are illuminated by lamps controlled from a switchboard.

Conductors, Conduits and Insulators:—

Insulator, G. Gerstenlauer, Williamsport, Pa., 546,383. Filed Mch. 27, 1895.
Form of insulator and wire support by means of which the usual binding or tie wires may be dispensed with.

Connector for Terminals of Electric Circuits, J. E. Neher, Pittsburg, Pa., 546,471. Filed July 30, 1894.
Intended for high tension circuits.

Insulated Electric Conductor, F. Clouth, Cologne, Germany, 546,579. Filed June 26, 1895.
A layer of gutta percha surrounding a layer of rubber.

Insulator, W. Dibb & A. Vickers, Syracuse, N. Y., 546,565. Filed March 13, 1895.
Has for its object to do away with tie-wires.

Distribution:—

Electric Converter, C. F. Scott, Pittsburg, Pa., 546,476. Filed Jan. 12, 1895.
In a converter, a secondary coil presenting a plurality of conducting paths leading to a single work circuit and having considerable breadth in a single plane, as nearly as possible parallel to the leakage lines in the converter.

Electrometallurgy:—

Anode for Electrolytical Apparatus, C. Hoepfner, Giessen, Germany, 546,-328. Filed March 26, 1894.
Consists of a conductive substance, the surface of which contains at least about ten per cent. of silicon.

Electrolytic Apparatus, W. A. Rosenbaum, Montclair, N. J., 546,348. Filed Dec. 20, 1894.
A compartment containing a layer of mercury which is adapted to receive a charge or deposit of the alkaline metal, an electrolyte in said compartment capable of oxidizing the alkaline metal and dissolving the oxide so produced, and an anode and cathode immersed in said electrolyte and separate and distinct from the mercury.

Electrolytic Apparatus, A. Sinding-Larsen, Christiania, Norway, 546,358. Filed July 9, 1894.
Has for its object the provision of means whereby the amalgam resulting from the electrolytical action upon the salt solution is spread out or converted into a thin sheet.

Apparatus for Extracting, Separating, and Refining Metals by Electrolysis, D. Tommasi, Paris, France, 546,364. Filed Sept. 24, 1892.
Anodes of discs of oxide of copper and carbon mixed, are revolved continuously.

Electrodepositing Apparatus, H. L. Bridgman, Blue Island, Ill., 546,463, Filed Dec. 22, 1894
An improvement in the class of anode devices for use in an electrodepositing apparatus in which the anode material is confined in a loose mass in a basket device to be immersed in the electrolyte.

Galvanic and Thermo-Electric Batteries:—

Thermo-Electric Generator, H. B. Cox, Hartford, Conn., 546,417. Filed Oct. 4, 1894.
Object of the invention is to provide improved means for uniformly heating a surface of a thermo-electric generator by means of a heated moving fluid with the employment of a simple and easily controlled mechanism.

Lamps and Appurtenances:—

Electric Arc Lamp, S. P. Parmly, Chicago, Ill., 546,388. Filed Oct. 26, 1891.
Consists in having electrodes, each composed of a series of carbon pencils, preferably but two, which are joined together by an intermediate rib.

Arc Lamp Mechanism, K. A. Lantau & C. J. Anderson, Chicago, Ill., 546,403. Filed Feb. 28, 1895
Modification in the Thomson-Rice lamp.

Electric Arc Lamp, D. Higham, Boston, Mass., 546,534. Filed June 4, 1895.
Provides means whereby the lighting or "striking" of the arc can be quickly and quietly accomplished.

Electric Arc Lamp, H. A. Seymour, Washington, D. C., 546,625. Filed July 20, 1895.
Consists in an arc-inclosing globe having a laterally adjustable cover seated directly upon its upper and open end, the cover being provided with an opening just sufficient in size to receive and admit of the feeding through it of the upper carbon.

Miscellaneous:—

Magnetic Pendulum-Level, T. Zanger, Erie, Pa., 546,501. Filed June 5, 1895.
Claim 1.—In a magnetic pendulum level the combination of a cylinder having a magnetic liner, and the glass front and back, with a shaft provided with needle points journaled in said glass front and back, and a pendulum with magnetized face and a pointer secured to said shaft.

Pliers for Trimming Electric Arc Lamps, R. D. Tackaberry, Lewiston, Me., 546,361. Filed Sept. 26, 1894.
Has grooves to seize and hold the carbon.

Electric Calculator, W. C. Porter, Arlington, Minn., 546,553. Filed Dec. 1 1894.

Electrical Piano, G. H. Davis, New York, 546,563. Filed June 17, 1895.
In an electrical piano, the combination with a revolving roller or drum, of a friction shoe pivoted above said roller and adapted to be brought into contact therewith, an electro-magnet arranged adjacent to and having its armature connected with the shoe, and a connection between the latter and the keys of a piano.

Billiard or Pool Table Shade and Reflector, E. F. Gennert, Brooklyn, N. Y., 546,611. Filed Mch. 16, 1893.
A combination of gas and electric light fixtures, whereby either may occupy the centre or focus of the shade or reflector.

Motors and Dynamos:—

Electric Motor, F. H. Williams, Greene, N. Y., 546,442. Filed Mch. 11, 1895.
Details of a reciprocating soft iron armature motor.

Railways and Appliances:—

Trolley for Railway Cars, R. Crommer, Philadelphia, Pa., 546,308. Filed Jan. 29, 1895.

System for Controlling Railway Trains, A. L. De Leeuw, Springfield, O., 546,306. Filed Jan. 25, 1894.
Provides means by which at certain central stations the operation of the automatic devices may be controlled when under the existing conditions of said automatic devices they would prevent the trains from approaching said central station.

Underground Conduit for Electric Railways, H. A. F. Petersen, Milwaukee, Wis., 546,389. Filed Mch. 19, 1894.
Relates more particularly to the construction of devices whereby a movable section of the conduit, together with movable sections of the conductors therein, may be readily adjusted, so as to enable contact devices carried by a car to pass freely through said movable section of the conduit and into engagement with branch conduits.

Trolley Wire Bracket, L. S. Pfouts, Canton, Ohio, 546,407. Filed Oct. 20, 1894.

Electric Railway, H. M. Montgomery, New York, 546,546. Filed June 14, 1892.
An intermediate auxiliary conductor formed of a continuous series of similar magnetic parts interlinked and in electrical contact with each other for connecting the supply conductor with the sections of the working conductor.

Electric Locomotive, S. H. Short, Cleveland, O., 546,560. Filed April 23, 1894.
Consists in certain features of construction and combinations of parts relating to the suspension of the motor on the truck.

Switches, Cut-Outs, etc.:—

Fuse Block, H. N. Potter, Allegheny, Pa., 546,475. Filed Oct. 17, 1894.
A fuse and insulating material surrounding the same, combined with a heating coil surrounding said insulating material and in series with said fuse.

Lightning Arrester and Cut-out, O. Gieseke, Lake Charles, La., 546,523. Filed March 26, 1894.
The line terminals are inserted in a tube and connected by a fluid.

Thermometric Circuit-closer, R. Pearson, London, Eng., 546,551. Filed May 2, 1895.
A thermometric circuit closing device consisting of a balanced thermometer mounted to oscillate on a horizontal axis.

Electric Fusible Cut-Out, D. N. Gleason, Brooklyn, N. Y., 546,618. Filed July 19, 1892.
The insulating base has an opening through it which is occupied by the fuse wire. U-shaped contact pieces are employed, to either side of which the fuse wire and the line conductor are attached by a bolt passing through the U.

Telegraphs:—

Dynamo Telegraphy, A. S. Harris, Minneapolis, Minn., 546,324. Filed Feb. 18, 1895.
An improved transmitter.

Telephones:—

Telephone, I. D. Smith, Pittsburg, Pa., 546,357. Filed May 3, 1895.
The telephone hook on its back movement throws the annunciator at the exchange.

PATENT NOTES.

THE FLEXIBLE MICA—PATENT ALLOWED ON APPEAL.

THE BOARD OF APPEALS of the United States Patent Office has just reversed the decision of the Primary Examiner, and has granted the right to protection upon what is termed "Flexible Mica" for insulation, recently introduced by the Mica Insulator Co. Mr. Edward P. Thompson, of New York, appeared for appellant.

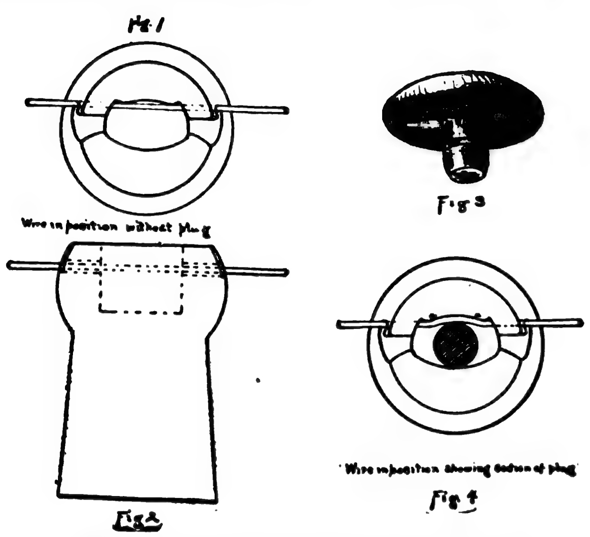
Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE NOTI INSULATOR.

We illustrate in the accompanying engravings a new insulator for which a patent has been granted to Albert Vickers and Wm. Dibb, of Syracuse, N. Y.

The insulator is designed to do away with tie wires, and is extremely simple. It consists of a body of the usual form screwing to the pin with a top provided with a cavity shaped as shown in Figs. 1 and 2, and having two opposite recessed slots.



FIGS. 1, 2, 3 AND 4.—THE NOTI INSULATOR.

The wire is laid in these grooves and a plug of the same material as the insulator, shaped as shown in Fig. 3, is pushed into the cavity. This plug holds the wire against one wall of the cavity, bending it very slightly, as shown in Fig. 4.

It will be seen that the roller action of the plug prevents the wire from moving laterally, the lugs keep it from flying up, and it is therefore securely fastened. The plug cannot come out, for the pressure of the wire against the slight groove in it holds it to its place securely enough, as there is no strain on it tending to force it out.

The advantage of this form of insulator is this. The wire rests on nothing but smooth surfaces of glass or porcelain, so that all chance of abrasion or mechanical injury is prevented. It is

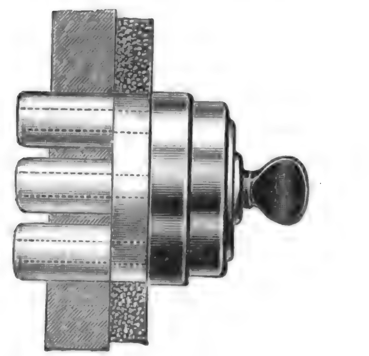
FIG. 5.—THE NOTI INSULATOR.

held to the insulator more securely than even a tie can hold it, and all the corrosion and scratching due to the tie wires is entirely done away with. It is evident, therefore, that broken wires and crossed lines will be reduced to a minimum on lines where this insulator is used, to say nothing of the very much less time required to construct a line with them, and the securing a perfectly uniform fastening at every insulator and one which can be readily inspected from the ground.

A perspective view of the Noti insulator is given in Fig. 5. This insulator is being put on the market by the Noti Insulator Co. of Syracuse, N. Y., and is made for any size wire.

THE PAISTE PORCELAIN SWITCH TUBE.

THE H. T. PAISTE Co., of Philadelphia, have just placed upon the market a new device which commends itself to all users of electrical switches. It consists of a porcelain tube with one common head and four lugs or tubes attached to the head. These tubes are placed in position by nailing an inch board between studding ½ inch from the face of the plastering, and boring four



PAISTE PORCELAIN SWITCH TUBE.

⅝ inch holes in the same to accommodate the four lugs or tubes. The wires are then put through the tubes ready for plastering, the latter just coming flush with the porcelain. The switch is then easily placed in position. These tubes save lots of money and time, are highly recommended by the underwriters, and prevent defacement of wall. These tubes are made only for the Paiste "Xntric" switches.

THE NEW "BUCKEYE" LAMP CATALOGUE.

Many years ago, when the electric light was very young, one of the French electrical journals devoted a large portion of its revenues for many months to the illustration of the uses to which the arc lamp and the search light particularly could be put. It was a very effective means of advertising, and while the apparatus shown lacked definiteness of detail, the picturesque effects presented have since been realized in actual occurrences all over the world. The idea finds itself again worked up in regard to the incandescent lamp, in the new catalogue of the Buckeye Electric Co. of Cleveland, just issued. The pages of this catalogue, besides illustrating the various lamps made by the Company, are profusely adorned with sketches intended to exemplify the numerous uses to which the beautiful little glowing bulb is now put. We show a couple of the sketches herewith. One of the best is that on the title page, including the trade mark of the company—the buck's head. The covers of the catalogue are of paper board in lavender and blue, and the back is reinforced with canvas and tied with cord. Altogether it is a very creditable and interesting publication, and is another evidence, if any were needed, of the Buckeye Company's desire to lead and excel in its chosen field.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE

Electrical Engineer.

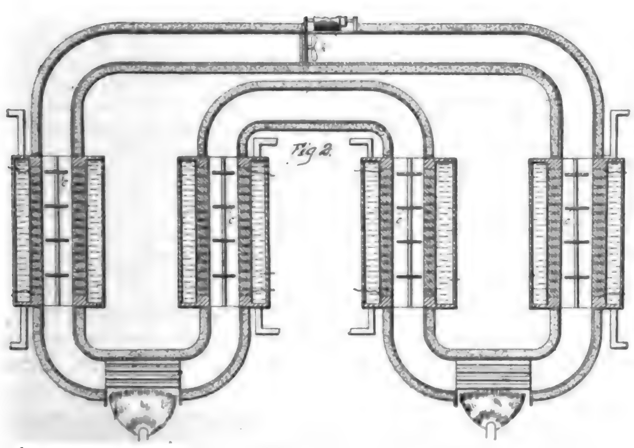
Vol. XX. OCTOBER 2, 1895. No. 387.

THE CIRCULATION OF HOT AIR IN THERMO GENERATORS.

BY

IN the accompanying engraving is illustrated one of the writer's inventions for the utilization of heat or thermal energy, in its direct conversion into electrical energy. The apparatus shown is an advanced form of the thermo electric generators described by the writer in THE ELECTRICAL ENGINEER of May 1.

The real objective in thermo-electric conversion, when the converter has been made mechanically efficient, is the economical utilization of heat. The apparatus here shown was invented with that end in view and particularly designed for the commercial production of electrical energy



COX'S METHOD OF HEAT DISTRIBUTION FOR THERMO-GENERATORS.

in large units. The principle involved in this device is the rapid circulation of hot air or other fluid heating means within the interior of one or more thermo generators. This circulation to be within a closed conduit.

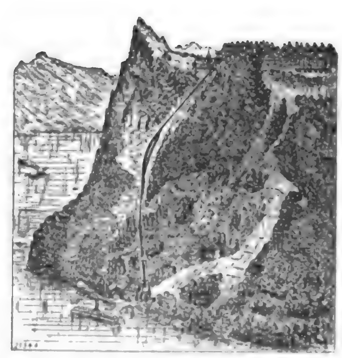
The circulation is preferably produced by a propeller *h*. within the conduit, the motive power being externally applied. This propeller, producing a rapid circulation of the heated air within the closed conduit gives a very uniform heat potential throughout the thermic circuit and such uniformity in heating is extremely desirable in the writer's form of direct converters. It is important to equalize the thermic load, or in other words to have all the active parts of the converter work with an equal E. M. F.

The generators used may be of any size or number. In the arrangement of this device, heat energy is very materially conserved and a large portion of the waste heat heretofore lost is now utilized. Gas jets are shown as a source of heat, merely for the sake of illustration. Gas is not ordinarily used, oil or coal being preferable, as being more primary. The natural tendency of a heat column is to centre or to come to a focus, the deflectors shown in the interior of the generators c c c are to break up this heat column and deflect and diffuse the same. The remainder of the apparatus is practically that described in the article above mentioned.

ROUNDABOUT NOTES IN ELECTRICAL EUROPE.—IV.

BY

ZURICH.



Up The Burgenstock.

THIS is one of the most beautiful cities in Switzerland, not only for situation, but by reason of the substantial character of the buildings, streets and public works. There are many things which will interest American manufacturers. While the city is most progressive, it has not yet come to a full realization of the possibilities of electric traction. There is a good field here, but the natural advantages of the place have not been utilized to the fullest extent. It is difficult to introduce new ideas. The people cling to old traditions and prejudices when dealing with tramways. Among other things, they believe most tenaciously in narrow gauge roads. There is an electric road running here which operates 12 motor cars. The line has several very steep grades, but in the main the city is level enough. Unfortunately, although this road is standard gauge, it is about to be converted into a three-foot gauge, and this must be regarded as retrogression. There can be little, if any, economy in changing to the narrower gauge. While it is true that a narrow gauge road costs less at the start, it is also true that it will entail a much diminished traffic. With a standard gauge road, on which cars of good capacity are operated, the receipts of the Zurich line would certainly be swelled far beyond the point which they will reach when the road is contracted into a narrow gauge.

We are indebted to Switzerland for many ideas and improvements, and the Swiss point with pride to the fact that they were the first to demonstrate the practicability of using turbines for long distance power transmission. Not far from here turbines have been running satisfactorily for years, furnishing power nineteen miles away. It is claimed, with truth also, that the turbines employed by the Cataract Construction Company at Niagara Falls, although built in America, were designed in Switzerland, and that all the turbine plans came from this region. Near Zurich is located the Oerlikon Maschinen Fabrik of which Mr. E. Huber is director. The chief engineer is Mr. Emil Kolben, and in his office one finds

complete files of THE ELECTRICAL ENGINEER and *Street Railway Journal.* This progressive concern employs 1,000 men and is very strong on dynamos, of which they make numerous sizes, adapted to all kinds of work. They also manufacture generators and street railway motors. The management is thoroughly posted on what we are doing in America and the extent of their information would be a surprise to some of your readers. Some of the heads of departments have inspected our large industries and are well able to form an opinion of the merits or demerits of apparatus on either side of the Atlantic.

GENEVA.

In this beautiful city, on the shores of Lake Leman, there is but one electric road running. This is the trolley road operated by the Compagnie Generale de Tramway Suisse, of which Mr. Antone Lavan is manager. The line does not reach the heart of the city and therefore cannot do the business it would if it had the right to come down to the Lake. Eight motor cars, with trailers, are operated, and in the near future it is expected that 16 more motor cars will be added. The line was opened for business on September 22, 1894, and at present is less than 4 miles long. During the next twelve months it is expected that 6 miles additional track will be laid. The motors are built by a Geneva electrical concern, The Electrical Industrial Company. The Compagnie Generale also owns 7 steam locomotives as well as all the horse-car lines. It is the steam line which will be electrified and the locomotives will be sold. At present in addition to hauling passenger cars, they haul all sorts of freight, and on the platform one may see barrels of cement, casks of wine, bales of goods, etc. There is no reason why electricity cannot be employed to handle this traffic to even greater advantage than steam. There are numerous narrow-gauge roads in Switzerland, and each differs from its neighbor. While most at present are operated by steam, it is most likely that ere long this will be replaced by electricity. The rack railways are most interesting and particularly so is the road running to the summit of Mount Pilatus. This is a modern road and differs from the ordinary rack road in that its engines have wheels which grip the sides of solid steel bars with teeth. These bars are located between the two tracks and there is no danger of their giving way as they are secured to solid masonry everywhere. Even a hint of the many interesting features of this road would take several pages, but a road such as this (operated electrically, however,) might be a better means of reaching some of our own mountain resorts than those we employ, to say nothing of the gain in speed and operating expenses. The braking system is excellent and in addition to mechanical brakes, air-brakes are used which act instantly and check speed the moment it passes a given point. The engines on the Brunig Pass route of the Jura-Simplon line are adapted to the ordinary track. They also have a centre axle, with teeth which mesh in the openings in the middle rail laid between the other two, where steep grades make climbing and descending dangerous. There is much water power unutilized along some of the roads. How long will it be ere it is harnessed?

Some roads are part electric and partly steam. There seems to be a great lack of standards and it is difficult to find many cars alike. They differ in headlights, drawbars, brakes, windows, entrances, etc., and remind one vividly of the old days before we saw in America the evolution of our present attractive rolling stock of standardized form.

SOME ALLEGED EXCEPTIONS TO OHM'S LAW.

It has been observed that amongst the liquids there are certain of low conductivity; for example, benzene, xylene, and turpentine, which do not seem to follow Ohm's law, but which, under the continued influence of a high electromotive force, show a gradual alteration in conductivity. These liquids also exhibit the phenomenon of electrical convection, a current of the electrolyte setting in from the one electrode, whilst the other appears simply to attract the repelled liquid. Recently, Emil Warburg has been investigating these phenomena. He employed mixtures of liquids which possessed low conductivity, gradually reducing the proportion of one of the constituents until the conductivity was nearly that of the other. Such mixed solutions as these were found still to exhibit the above phenomena. The behavior of these solutions, in fact, was such that Warburg is led to the conclusion (*vide Ann. Phys. Chem.*, 1895 [2], liv., pp. 396–433), that they contain an electrolyte in a state of great dilution, upon which their conductivity depends. He suggests that the extraordinary behavior of the so-called pure liquids is capable of a similar explanation.

HEALTH PRECAUTIONS IN ACCUMULATOR FACTORIES.

Although machines have been devised, and are used to a considerable extent for filling accumulator grids, most of the pasting is still done by hand. Hand work is much dearer, but it is most prevalent, because a machine can only deal with one particular size of grid. Now hand labor which involves contact with lead compounds, is attended with great risks to health, owing to the poisonous nature of these materials. Hence means should be consistently adopted to counteract these risks, and the simplest and most effective means of all is cleanliness. Writing in the *Zeits. f. Elektrotechnik u. Elecktrochem.* (1895, p. 412), P. Schoop advises the following precautions for minimizing the danger of filling accumulator grids by hand. He would enforce the greatest personal cleanliness amongst the workmen. At meal times, and whenever work stops, the men should be compelled to wash their arms, hands and faces with warm water and soap, and also to change their clothes. The working clothes should be made entirely of wool; they should be brushed and shaken every day when taken off, and should be washed every week. The pasting room should be well ventilated; its floor should be made of asphalt, and should be washed out twice a day. No person who is not sound in health should be employed in the operation of pasting; nor should anyone be kept at it continuously for more than a fortnight at a time, after which he should have a fortnight's work out of doors. As the first sign of lead poisoning appears in the digestive organs, the workman losing appetite, and suffering from vomiting, these symptoms should be carefully watched for, and medical advice at once afforded. If the proper precautions are taken, there is no reason why a workman should not enjoy good health, and live a long life, though employed in this dangerous occupation.

HERMITE SANITATION PROCESS.

The English War Office have instructed Messrs. Paterson & Cooper to proceed with the erection at Netley Hospital of the Hermite sanitation plant, the cost of which has been provided for in this year's Parliamentary estimates. The corporation of Cape Town have also ordered a plant for producing electrolyzed seawater with a view to the Hermite process being applied to the sanitation of Cape Town.

RELATIVE HEATING PROPERTIES OF VARIOUS SOURCES OF LIGHT.

The following comparison, due to Prof. Palaz, will, the *Engineer* thinks, be useful to electrical engineers in presenting the advantages of electric lighting from the standpoint of coolness. The figures quoted are relative to a given quantity of light:—Arc light, 4; incandescent light, 14; kerosene, argand burner, 331; gas, argand burner, 380; candle, 478; gas, butterfly burner, 511. The heat question is a very important one, but it is as nothing compared with the question of vitiated atmosphere. In this respect, of course, electricity compares still more favorably with all other sources of artificial light.

POWER TRANSMISSION.

STANLEY TWO-PHASE POWER TRANSMISSION PLANT, AT ANDERSON, S. C.

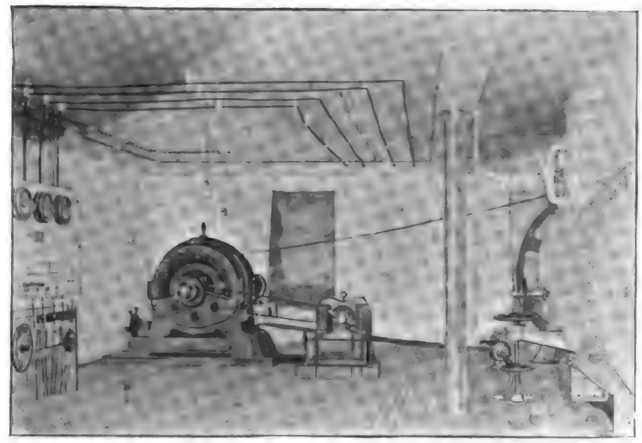
High Shoals Water Power.

To the Anderson Water, Light and Power Company of the City of Anderson, S. C., belongs the credit of having installed and put into successful operation the first plant in the South for the long distance transmission of electric power. For this purpose they have developed a small water power on Rocky River, a tributary of Savannah River, known as High Shoals, six miles south of the city and capable of yielding about 200 H. P. with the present machinery.

The river is 160 feet wide at the dam and has a natural fall of 35 feet in 800, and the whole flow is diverted into the canal by a dam of from six inches to two feet in height. The canal follows the foot of the hill to within 200 feet of the power house, and is from ten to twenty feet in width and from three to ten feet in depth. From the end of the canal the water is carried to the power-house in a wooden race set on trestle bents and is there delivered through an iron flume to the turbine wheel.

The plant at the power-house consists of one 24-inch horizontal "McCormack" turbine wheel set in an iron penstock large enough to contain two such wheels (being so designed that the plant might be doubled if so desired). The penstock rests upon the floor of the power-house on steel I beams about half way between the top of the head water and the tail race, the water being carried from the wheel by an iron draft tube extending from the penstock into the tail race. The wheel, flume and penstock were built and furnished by Messrs. J. & W. Jolly of Holyoke, Mass. The turbine shaft carries an 84-inch drive wheel, having an 18-inch face and weighing 5,200 pounds, and to this drive wheel is belted the generator, placed about 15 feet in front of it.

The generator is an S. K. C. two-phase alternator of 150 K. W. capacity, built especially for this plant by the Stanley Electric Mfg. Co. of Pittsfield, Mass. It runs at 800 revolutions per minute and is wound for an initial E. M. F. of 5,500 volts. In this respect it is probably the only machine of its size in this country having so high an initial E. M. F. The advantage of this high voltage will be readily understood since it obviates the necessity



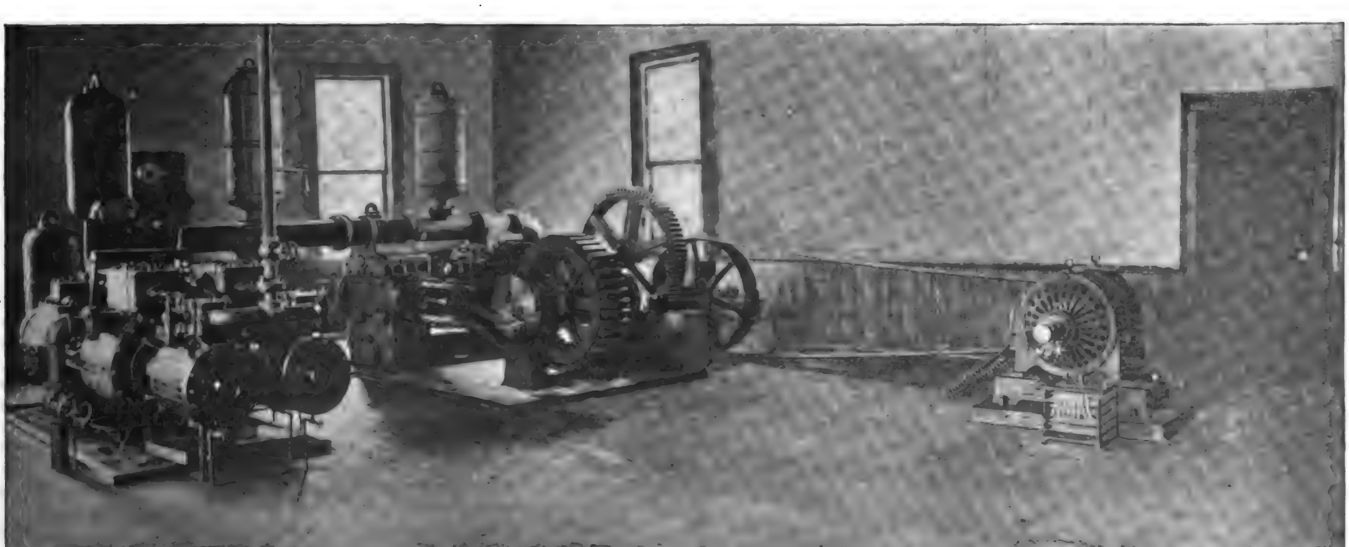
INTERIOR OF STANLEY TWO-PHASE POWER HOUSE, HIGH SHOALS.

of step-up transformers, thus effecting a large saving in the first cost of the plant as well as permitting a greater simplicity and economy in operating. In addition to this advantage, this generator, in its construction, is a model of simplicity and durability.

STANLEY TWO-PHASE STATION, ANDERSON, S. C.

It contains no moving wire, no commutators or brushes, it regulates inherently and automatically, and is operated with a minimum of trouble and expense.

The exciter used to excite the field coils of the generator is a



INTERIOR OF POWER PUMPING STATION,—STANLEY 30 H. P. TWO-PHASE MOTOR DRIVING SMITH-VAILE DUPLEX PUMP.

Mather machine and is of a size sufficient to excite two such generators. The current is taken from the generator to the switchboard of polished marble 4 x 8 feet, and contains two ampere meters, one for each phase of the current, a voltmeter, two magnetic circuit breakers, one for each phase, and the rheostats, one for the generator and one for the exciter. The current is carried from the switchboard to a sub-station in the city over four No. 4 B. & S. bare copper wires and is there reduced through a bank of four Stanley transformers to a voltage of 1,040, the loss in the line from the power house to the city being only 8¼ per cent. From the step-down transformers the current is carried to another switchboard in the sub-station and thence distributed throughout the city. A view of the sub-station is shown on the preceding page.

From this circuit the Company now operate incandescent lamps and arc lamps, and motors. A few arc lamps have been installed for some months past for the purpose of testing them, but the Company is now preparing to substitute arc lamps for all street lights and have placed an order for 50 lamps with the Helios Electric Co., of Philadelphia.

Several small motors are now at work in the city driving ceiling fans and printing presses, and the Company have one 80 H. P. S. K. C. induction motor made by the Stanley Company, with which it drives its Smith-Vaile duplex power-pump. This pump has a capacity of 720,000 gallons per day, but the stand pipe has only a capacity of 200,000 gallons, being 100 by 18 feet. It is situated about one-fourth of a mile from the sub-station and when full offers a pressure at the pump of 75 pounds. The motor has been in operation for several weeks and is performing its work with entire satisfaction. The pumping plant is in the sub-station and a view of the motor and pump is given on the preceding page.

As at first operated this plant was equipped with steam pumps and alternators of the type built in 1890, all driven by steam, and the officers are more than pleased with the new plant and its working. Mr. Wm. C. Whitner, who designed and installed this plant, is now engaged in installing a similar though somewhat smaller plant for the city of Elberton, Georgia, in which the current is to be transmitted five miles.

The officers of the Company are: Dr. S. M. Orr, president; Wm. C. Whitner, general manager, chief engineer and secretary and treasurer, and J. L. Mauldin, superintendent.

CARNEGIE STEEL WORKS.

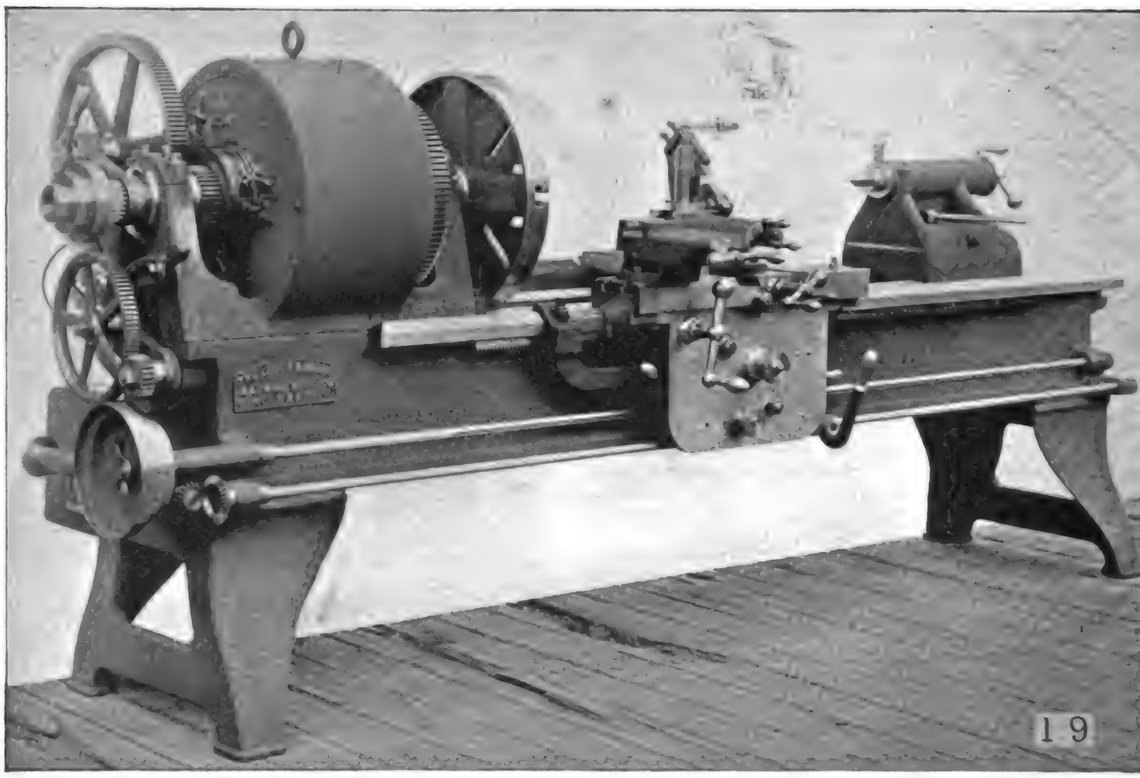
THE GENERAL ELECTRIC COMPANY has just secured a contract from the Carnegie Steel Company, for a 150 K. W. monocyclic generator and the necessary station equipments. The contract was awarded on the merits of the monocyclic system for combined light and motor distribution.

A LODGE & DAVIS 21 INCH MOTOR-DRIVEN ENGINE LATHE.

THE accompanying engraving illustrates a lathe in which the design includes an electric motor, taking the place of the cone pulley. The lathe is reversed and the speed regulated by the movement of the rod at the front of the machine; this with the back gears, arranged as usual, gives not only a much wider range of speeds than can be obtained by a cone pulley, but a much more finely graduated speed; in fact the speed may be anything from the highest to the lowest desired.

The armature is mounted on a phosphor bronze spider with a carrier disc which revolves freely on the spindle like a cone pulley. It is surrounded by pole pieces inclosed in a housing, the lower half of which is cast in one piece with headstock proper, to which the upper part is substantially fitted and secured by means of four bolts. This construction forms what is known as an iron clad motor, entirely free from external magnetism. This is necessary in order to keep small particles of dust and iron from adhering to the lathe, making it impossible to keep it clean.

Among the advantages secured by such an application of electricity are that tools may be placed independently of fixed conditions overhead, such as shafting, cranes, etc., and with regard to the arrangements best suited to handle the product most conveniently, and the operator has best control of his machine, especially when a variable speed is necessary.



LODGE & DAVIS 21 INCH MOTOR-DRIVEN ENGINE LATHE.

We may call particular attention to the construction of the lathe with regard to the position of the lead screw which is placed on the inside of the bed directly under the front "V" and is enclosed in a metal tubing protecting it from dirt and chips. In this position it takes hold of the carriage directly beneath the line of strain, and obviates that twisting tendency which is so common on lathes where the screw is placed on the outside of the bed. All the feeds of the carriage can be thrown in and out or reversed from the front of the apron. This is a particularly desirable feature inasmuch as the operator is not compelled to leave his work, and it does away with the complicated gearing in the headstock. The carriage is provided with a stop, which throws out the feed automatically and may be set at any point along the ways. This is very convenient for turning or boring a given length, and also prevents the lathe from being damaged by any carelessness on the part of the operator. The spindle is hollow and of large diameter; the boxes are made of the best phosphor bronze, and are arranged for taking up the wear.

This lathe is manufactured by The Lodge & Davis Machine Tool Co., of Cincinnati, Ohio, who were one of the first to introduce motor-driven machine tools. As the benefits to be derived from the direct driving of machine tools become better understood, their use is growing steadily.

ELECTRIC LIGHTING.

LODGE ROOM LIGHTING.

BY A. E. DOBBS.

Many a wireman is stumped when called upon to lay out wiring for secret society lodge rooms, and even those who belong to secret societies do not always know how to use electrical effects to the best advantage. Electric lighting is especially desirable for this kind of work on account of its flexibility. The following

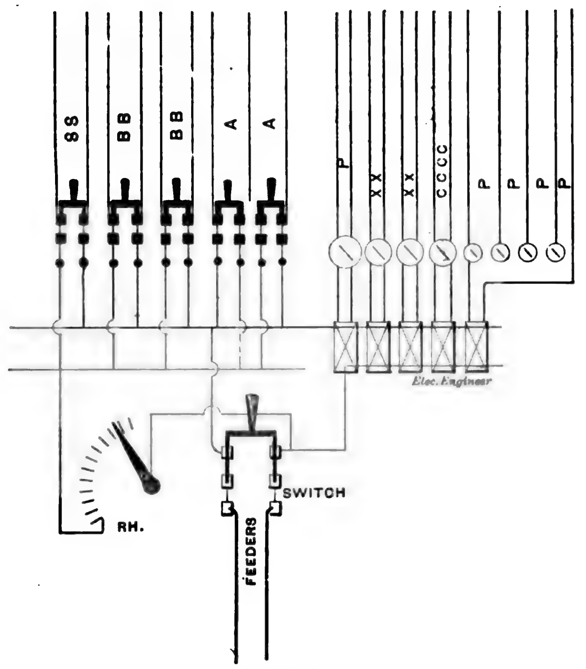


FIG. 1.

design applies to the common type of lodge room and as will be seen upon studying it adapts itself to any kind of work required.

Lodge rooms should have plenty of light. At times very

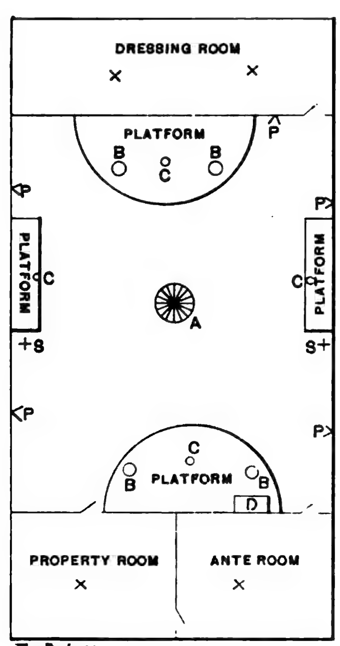


FIG. 2.

brilliant effects are desired while at other times total darkness is wanted, with all degrees between the two extremes.

Figs. 1 and 2 show the lighting plan of most halls in which A is a centre chandelier which should have at least 12 lights. At each end platform are two standard uprights of, say, three lights each, or a chandelier from the ceiling might be used instead, if preferred. At each side platform are ordinary portable desk lights. At intervals around the room are placed plugs P P P P which can be used for portable lights for scenic effects or connected to fan motors or heating apparatus. They should be near the floor. S S are side brackets. The desk lights, C C C C, are simply dark lantern reading lamps and are to be used when the official at that particular desk has to read his part. For the purpose of controlling the lights in the lodge room, a rheostat R H is placed in circuit.

It will be noticed that the two switches connected to the centre chandelier are connected together making a three-wire circuit. The advantage of this is that on ordinary occasions the lodge will not need more than half the light from this chandelier and hence can throw every alternate light off. The spare circuit P is run to the end of the room and left there to be used as needed. Some societies wish to give amateur theatricals and a chance to use from 30 to 50 lights is sometimes very convenient. This wire should not be smaller than No. 8.

It will be noticed that the lodge room switches are all of the knife pattern. Knife switches work silently and on that account should be used; for after the Most Mighty Puissant Royal Chief has sweated a candidate for three quarters of an hour and finally arises to pronounce sentence it breaks in on the solemnity of the occasion to hear the "whang" of a snap switch. The plugs are on separate single pole switches and when used for portable lights can be employed in a very striking manner in some scenes by turning them off and on one after the other. The switchboard of course should be of slate or marble. Somebody belonging to the lodge should be taught how to handle the switches and rheostat and his title after he has been officially appointed would probably be "Worthy Chief Electrician," "Ajax" or "Prince of Light and Darkness."

I know of five lodge rooms wired in this manner and the system gives general satisfaction. With opportunities for the many varied effects possible with this system the members will soon learn new and ingenious combinations and will be pleased with the thought that they are inventors and thoroughly up to date.

LAYING A PHILADELPHIA CORNER STONE BY ELECTRIC LIGHT.

The corner-stone of the new building of the Belmont Avenue Baptist Church, Belmont and Westminster avenues, Philadelphia, was laid a few days ago, electricity providing the light for all the interesting services connected with the event.

THE BLACKSTONE, MASS., LIGHTING CONTROVERSY.

The Blackstone, Mass., representative of the Woonsocket, R. I., Electric Machine and Power Company has been served with a subpoena to appear in the supreme court at Worcester on the first Monday in October on complaint of the board of gas and electric light commissioners. On Aug. 15 the board issued an order that the company named "is hereby directed and requested to supply to the inhabitants of the town of Blackstone electric arc lights for the purpose of lighting the streets of said town." The lights were to be such as are generally known as nominal 2000-candle power. The board fixed the price at 42 cents per light.

It is on account of the company's failure to supply the lights as directed that the board brought its complaint. The company is supplying lights at 50 cents in Woonsocket and declined to give Blackstone service at a lower rate.

THE TENNESSEE CENTENNIAL EXPOSITION AT NASHVILLE.

Director General Lewis of the Tennessee Centennial Exposition of 1896 has accepted a design of a device submitted by Mr. J. C. Wharton. It is to be a crown sixteen feet in diameter made of incandescent globes so as to show the words, "Tennessee Centennial, 1896," no matter from which side it is viewed. It will be set to revolve, either by the action of the wind or by electric power, upon the highest tower on the grounds. At night the vari-colored electric lights in the revolving frame will present a glittering crown in the heavens, with the chosen words in dissolving shades, that can be seen for miles around.

DIRTY GLOBES AT OAKLAND, CAL.

Reporting on some city lighting at Oakland, Cal., recently, Messrs. Hasson and Hunt, of San Francisco, stated, among other things, that the company had allowed its globes to get so dirty that 20 per cent. of the light was lost; while the adjustment of the carbons was very bad.

MR. HENRY ALBERT, E. E., has been appointed chief engineer of the Jacksonville, Fla., Electric Light Co. The plant comprises 14 dynamos, 4 engines and 6 boilers. Mr. Albert enters upon his new duties at once.

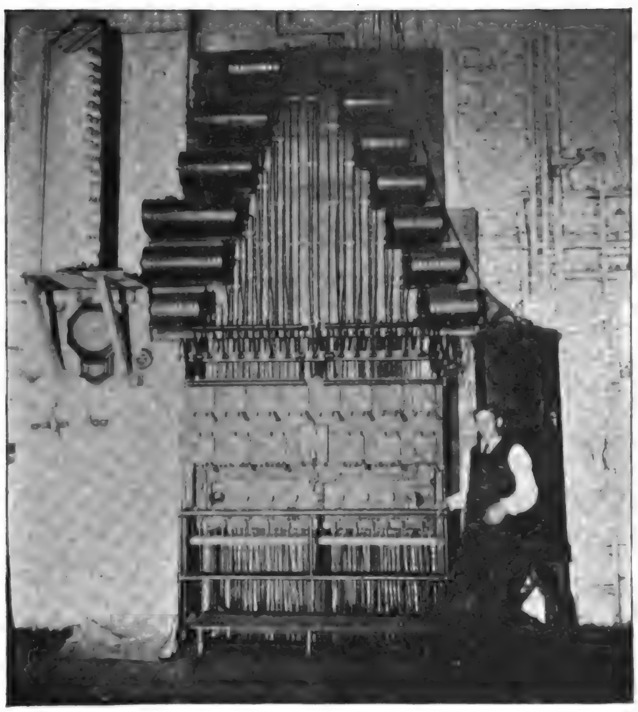
A NOVEL THEATRE SWITCHBOARD.

The electric light controlling stand at the Haymarket Theatre, Chicago, of which we give an illustration, shows the arrangement and position of the Meissner stage dimmer manufactured by the Washington Electric Company, of Chicago, Ill.

These dimmers have no segments, but make the contact direct on the resistance wire, and there being a great number of convolutions of wire and each convolution making contact, the changes from light to dark, or *vice versa*, can be made so gradually and evenly that flickering or jumping of the lights is entirely obviated, and the finest scenic effects can be brought about with the greatest smoothness with a quarter turn of the regulating handle.

As will be seen in the illustration there are thirteen dimmers mounted on the board, the pocket rheostat at the top to the right acting independently from the others, it being used principally for bunch lights. The entire thirteen are connected to the same number of small levers by means of connecting rods which make them all equally accessible for throwing in and out of circuit.

By means of two horizontal bars which touch lightly the connecting rods, six dimmers at each side of the board can be operated at once, by pulling out or pushing in the bar when the circuit is to be thrown in or out. Where only a few of the lights are needed the dimmers which operate them can be used separately



Electric Light Dimmers, Haymarket Theatre, Chicago.

by means of their respective levers. There are 14 double pole four-brake switches and one red, white and blue foot light switch, besides some small switches for auxiliary lights.

There is also a very neat arrangement at the bottom of the board where, by means of another horizontal bar which is attached to a lever, a platform at sufficient distance from the floor to enable the operator to reach all the switches and dimmer levers can be drawn out for use, or pushed in out of the way, as occasion may require. This and the arrangement of the switches was designed, and the whole erected under the personal supervision of Mr. F. N. Batcher, the chief engineer of the building.

This switchboard has a capacity for 1,800 lights, the current being generated by three 600-light United States direct current dynamos, the motive power used being one Ide and one Ideal engine, for which steam is supplied by three tubular boilers, two of 80 H. P. and one of 100 H. P. capacity.

There are also four of the Meissner improved theatrical focusing arc lamps in operation on the stage of this theatre. This lamp is not only well adapted for use in the gorgeous spectacular plays which have become so popular during the last few years, but also for all other plays in which special light effects are used.

Minneapolis, Minn.—The Chloride storage battery plant being put into the new Court House will have a capacity of 1,600 ampere hours. It will be used for night lighting and to run an occasional elevator.

MISCELLANEOUS.

PHASING TRANSFORMERS.[1]

BY CHARLES S. BRADLEY.

The polyphase motor is so good as to need but very little, if any improvement, but this is so familiar to the Institute, that I need not go into details. I think the time is not far distant, when we shall be able to fill out with the alternating currents, any engineering problem that may be required of us. We will be able to take old plants and modify them to do any work which may be necessary. One of the important links to round out the art, seems to be the phasing transformer, so that we can take a

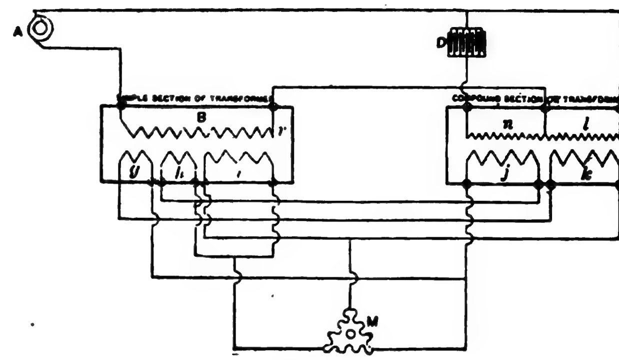


Fig. 1.

single phase alternating current, and convert it into polyphase of any desired number.

I have chosen for my work, the conversion of single phase to three-phase, because the three-phase motors which we have been able to construct, give us very much less trouble than the two-phase. In a series of experiments, I have found that the two-phase motor would run at a number of speeds, especially when supplied with current from a phasing transformer. I suppose the trouble arose from harmonics, but of this I am not certain. The triphase motor never has given us any of this trouble. These experiments, however, were carried out before the transformers had been refined; and, now that we are getting more perfect results, I think it is very probable that we could return to the two-phase motor and get much better results than when first tried. The following is a description of an arrangement of condensers and cores to produce polyphase and single phase alternating currents. Many different arrangements of condensers and induc-

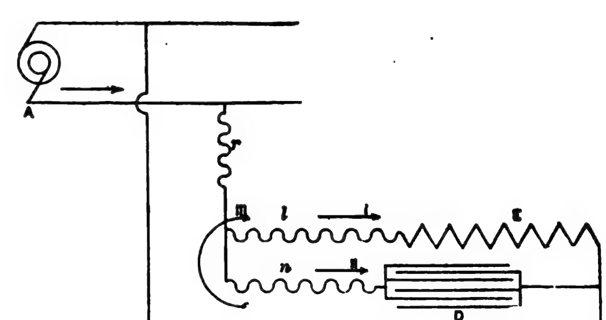


Fig. 2.

tances have been tried, and all have failed to keep their phases at a working relation, except the one I am about to describe.

A diagram of the phasing transformer and connections with the generator and motor will be found in Fig. 1, A being the generator, B the simple section of the transformer, D the condenser, and M the motor; *r*, primary of the simple section of the transformer, *n* and *l*, primary of the compound section; *g*, *h* and *i*, secondaries of the simple section of the transformer, and *j* and *k* secondaries of the compound section. The primary of the simple section of the transformer is in series with the compound section and condenser. By the proper adjustment of capacity and inductance, the magnetic flux in the core of the compound section is approximately 90 degrees in phase behind the simple section; then, in order to get three phases from the two, I resort to resultants in the secondaries: *g* and *k* constitute one phase,

1. Abstract of paper read before the Amer. Inst. of Elec. Engrs., Sept. 25, 1895.

h and *j* a second, and *i* the third. The essence of this invention rests in the arrangement of the compound section of the transformer and condenser. In order to explain the theory involved in this, refer to Fig. 2, in which A is the generatór, E, the inductance, D, a condenser or capacity, *l* and *n* represent the leads to the inductance E, and to the capacity D. If the generator is generating an electromotive force in the direction of the arrow, Fig. 2, a current will flow through the lead *l* and the inductance E, as represented by the arrow I, and through *n* into D, in the direction of the arrow II, as indicated by the curves in Fig. 3; that is, during

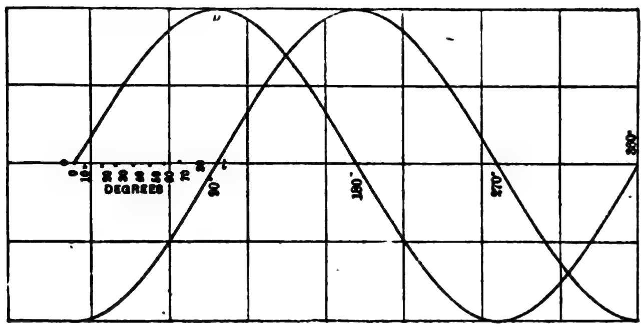


FIG. 3.

the rise of the electromotive force through the machine from the point, *o*, to the top of the wave at *p*, the current will flow in parallel into or through the inductance E, and the capacity D, Fig. 2. As soon as the wave of the electromotive force commences to decline from the point *p*, the condenser will begin to discharge and the current flowing from it will be in the direction of the arrow III, Fig. 2. Also, at the same time, the inductance will discharge its energy by a current in the direction of arrow III, so that the current represented by arrow III will cross the zero line at point *t*, Fig. 3, or is delayed by a time equal to 90 degrees. Thus, we see that the current represented by arrow III will be lagging in its time period considerably behind that in the lead *r*, represented by curve *o–p*. Now, if we wind the lead *l* and the lead *n*, upon an iron core as shown in Fig. 4, in opposite

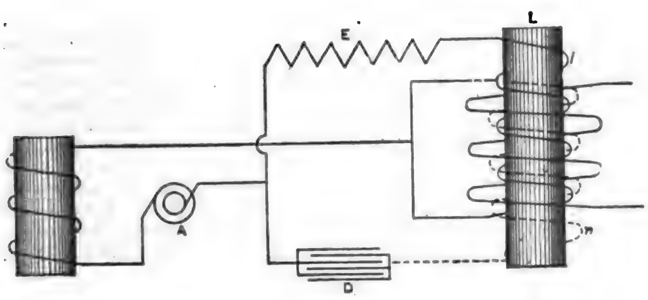


FIG. 4.

directions and of the same number of turns, and have the inductance E bear a proper relation to the capacity D, so that the currents represented by arrow I and arrow II shall be equal, no magnetic flux will be produced in the core during the rise of the potential of the machine from *o* to *p* on the curve, but during the fall of the electromotive force of the machine, and during the discharge of the inductance and condenser which is represented by arrow III, Fig. 2, the currents flowing through *n* and *l* will be in series and flowing in the same direction; consequently, the magnetic flux will be approximately 90 degrees later than it would be if charged directly from the machine. I have represented in Fig. 2, a section of lead by *r*, and it will now be clearly seen that the current in the lead *r*, will have a phase difference from the combined or resultant phases in the leads *l* and *n*. Furthermore, a current in the lead *r* will be in lead of the electromotive force of the machine, because the inductance and the condenser, previously described, cut off the flow of the current before the machine has reached the zero point, and when the lead *r* is placed upon an iron core as shown in Fig. 4, it has a tendency to lag, which counter-balances the lead and leaves the main line current somewhere near in phase with the E. M. F. of the generator.

Refer now to Fig. 4, where the leads *l* and *n* are wound in opposite directions, and completely interlaced upon the iron core L, the generator, inductance and capacity being indicated by the same symbols as in previous figures. The lead *r* is here wound upon the second iron core, which constitutes the primary of the simple section of the transformer as shown at B, Fig. 1. In reducing to practice and applying the transformer to an induction motor, we find that the inductance E, can be dispensed with, as the apparent inductance produced by the motor furnishes all the lag necessary; and, it will be noted, that in Fig. 1, the extra inductance which we used in our first experiments, is left out of the combination. The lead from the simple section of the transformer, it will be noted, goes to the centre of the compound section. This diagram does not represent the true condition of the compound section, for the windings *n* and *l* are together, or, as before mentioned, interlaced upon the core. The magnetic flux in the two sections of the transformer are approximately 90 degrees apart. The secondaries are therefore wound each partially upon the two cores, so that the three resultant phases may be produced from two, this being in accordance with Mr. Fred. S. Hunting's invention for changing two phases to three.

Mr. Scott's invention for changing two phases to three, may also be used, and is shown in Fig. 5. Making the resultants in this manner by means of the secondary windings contributes also to steadiness of phasing. If desired, two secondaries having a proper two-phase relation may be used on the motor.

The experimental work in which I have been greatly assisted by Messrs. Hulse and Chapman, has occupied a long time and has passed through a great many stages. The ½ H. P. motor gives powerful starting torque. (The motor was shown in operation.)

I want to bring to your attention one feature of the compound coil used in combination with the condenser, which will be found in Figs. 6 and 7. If we suppose a direction of motion as shown by the arrow and the current in the condenser branch leads by 90 degrees, which is represented at *b*, and the current in the inductance branch lags by 90 degrees as indicated at *c*, and the wires carrying these currents are wound in opposite directions upon the core, we will have a resultant current, which is represented by extension *d*. Increase of load changes the phase relation of the individual branches, but not the resultant secondary, and this is

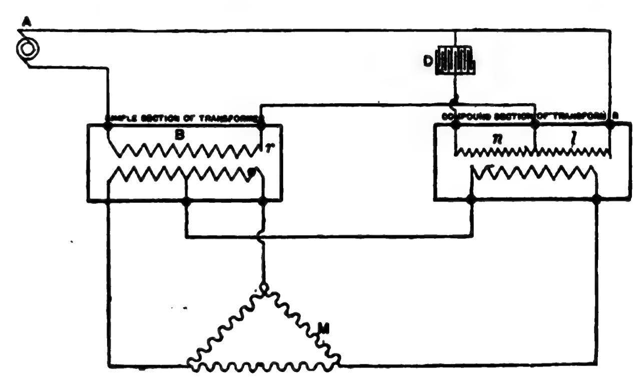
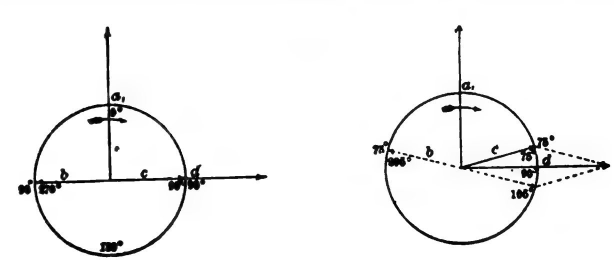


FIG. 5.

explained by reference to Fig. 7, where a 75 degree lead, and a 75 degree lag are represented by the respective branches, and as the branches are wound in opposite directions, we find that when *b* is turned over, it becomes a lag of 105 degrees, and the resultant of 75 degrees and 105 degrees again produce 90 degrees lag, and the value again represented by the extension *d*, the value of the current is slightly less, but its resultant phase is the same as is represented in Fig. 6. This explains the steadiness of phasing which we are able to obtain.

The power factor is found to be very good. The current in the main line, feeding the transformer varies from 10 degrees lead at full load. to 35 degrees lag at no load, and the motor at starting produces the same effect as when working at full load, so that we have very good phasing for starting and full load, as well as a good power factor, it being 82 per cent. even at light loads, and



FIGS. 6 AND 7.

the probability is that we will have very much better results upon larger sized transformers.

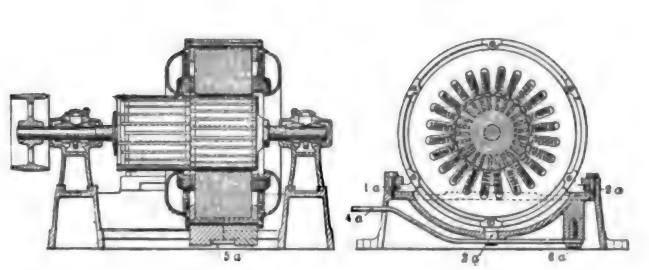
The condenser in this combination fills two very important functions, first assists in the phasing, and second prevents the lag upon the line. This arrangement does not prevent the idle currents flowing in the motor circuits, and the secondaries of the

phasing transformer, and we find in small motors with the high period of 140 cycles that the apparent energy in the motor circuits is sometimes two and one-half times the apparent energy in the main line. The capacity of condenser for a one-half horse-power motor when 1,000 volts are supplied to the transformer is about 2.4 microfarads. Our condenser for this size, without connections, occupies a space of a cube four inches on each side, and capable of enduring 3,000 volts, or a factor of safety of four, as the voltage on the condenser is about 700. Of course, it will be understood by those familiar with the designs of induction motors, that it is impossible to design a small motor with small power factor, as the air-gap necessary for mechanical construction has to be so large in proportion to the size of the motor.

Many attempts have been made by placing the condenser in direct connection with motors to produce rotary fields, but have so far been attended with little success; as the trade requires the motor to be of comparatively low voltage, which calls for a large capacity in the condenser, and as the output of the condenser of a given capacity is proportional to the square of the voltage, it will be seen how advantageous it is to place the condenser in combination with the primary of the step-down transformer.

It may seem trite to call your attention to the fact that the transformer reduces the voltage at the same time it does the phasing, but I think it is so important that I wish particularly to emphasize the fact. It is also of great importance that the device has no moving parts.

While the principal use for this device at present seems to be the application of polyphase motors to single phase lighting systems, many new ones, undoubtedly, will be found. It may seem bold to think of applying this to long-distance trolley railroads but I am hoping to have it done. It is much more simple to have one trolley wire with track return, than to have two trolley wires which would be required by the direct application of polyphase systems. A large amount of power requires either a large current or high voltage, in order that the resistance of contact of



Figs. 8 and 9.

whatever device is used to make connection to line need not be too great. As viewed at present, it seems as if the alternating current must be used for this work. If so, and unless the traffic is extremely frequent, it will take many more transformers, if they be placed along the line, than if the transformation is made upon the car or locomotive; because the transformers along the line having no trains or cars near them, would be idle. If the voltage is stepped down on the car or locomotive, it is just as economical to do it by the phasing transformer, with the exception of the added weight of condensers, which for a 1,200 h. p. locomotive will be about two tons, and this is not of consequence on so large a power.

Cuts of the motor are shown in Figs. 8 and 9, the rotary field being the exterior or stationary part, and the secondary or induced constituting the armature. The armature is composed of two sections, or practically two armatures end to end upon the same shaft, one of the armatures having a low resistance winding and the other a comparatively high resistance; the field is placed over a high resistance for starting, and shifted by means of a lever over the low resistance, when it has nearly attained speed. Of course, this arrangement is for securing the starting up of the motor, and has nothing to do with the phasing transformer, and the motor might have rings for connecting the starting resistance to the armature and operate quite as well. The sliding of the field gave trouble, as the air-gap has to be small, and the play at the sides (noted 1*a* and 2*a*) allowed the armature to strike against the field, and when a tight fit was made, which would work easily when cold, it would stick fast when the motor rose in temperature; the writer therefore decided to give it quite a clearence at these points, and give it a guide at the bottom of the field shown at 3*a*. This being central and comparatively thin, the expansion is not sufficient to cause sticking, also the guides at 1*a* and 2*a*, being thin vertically, they may fit close and still slide easily. The lever for moving crown back and forth is shown at 4*a* Fig. 9, and 5*a* Fig. 8. It fits loosely, having a fulcrum at 6*a*.

ELECTRIC FURNACES AND THEIR APPLICATION TO THE TRANSFORMATION OF CARBON INTO GRAPHITE.[1]—IV.

BY CH. STREET.

On May 25, 1893, my colleague, M. Girard, and I took out a patent, the subject of which is a continuous electric furnace, which enables us to heat or treat any kind of material by electricity by causing it to circulate or pass in a continuous manner through the furnace. I lay stress from the beginning of the essential feature, which lies in passing the substance to be treated through the furnace. In the electric furnace the high temperatures are extremely local, and when substances are put into the furnace in

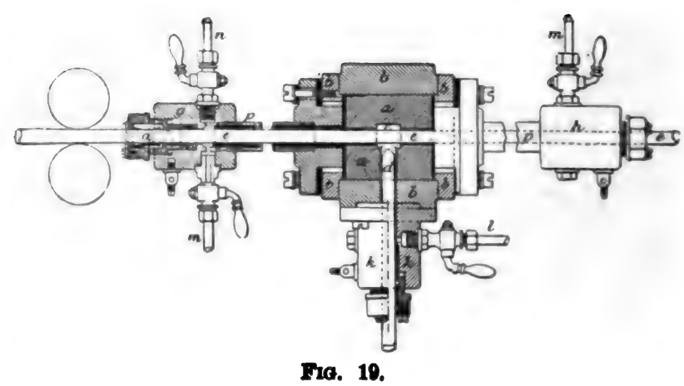


Fig. 19.

the ordinary way they are heated in a very irregular manner, particularly when we have to deal with moderately good conductors of heat. To overcome this, we may increase the number of electric "burners," but by this means we reach a current consumption quite out of proportion to the result obtained. On the other hand, the circulation of the material through the furnaces permits of the establishment of continuously producing furnaces. Fig. 19 suows, partly in section, partly in elevation, a furnace applicable to the heating of solid materials in the shape of rods, bars, or wires. The apparatus consists of a block of refractory material *a* in one or more parts secured by an external metal frame *b*. In the centre of the block there is a metal cavity *c*, which is, properly speaking, the heating chamber. In this cavity there is an orifice, by which the carbon *d* penetrates into it, and a tunnel traversing the walls of the furnace from one end to the other and into which the bar *e* which is to be treated is introduced. This bar *e* is given a motion of translation which should take it through the furnace and the heating chamber at a rate depending on its mass, and the temperature to which it is desired to raise it. The actual heating chamber is composed of a block of carbon in one or more pieces according to the size of the apparatus. In the model shown in the illustration the circuit is between the piece *e* to be heated and the carbon *d*. The arc is struck between the two electrodes, keeps itself in a fixed position, notwithstanding the motion of *e*,

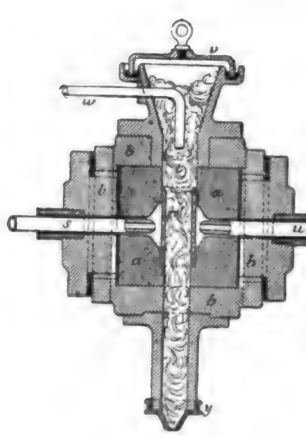


Fig. 20.

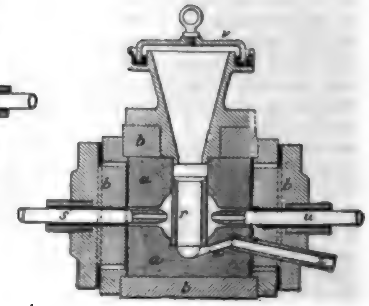


Fig. 21.

and successively springs from every point along a generatrix of the piece to be heated, raising these points to a very high temperature. It is easy to see that the speed with which the piece moves determines the average temperature of each element. When the heating is required to take place in any particular gas the piece *e* passes through stuffing boxes *g* and *h* and the carbon *d* through the stuffing box *k*. The gases enter and leave at *l* and *m*, and at *n* a manometer is fixed. The current is brought to *e* by a rubbing contact at *o*. The length of the arc between the carbon *d* and the piece *e* can be kept constant by means of one of the arrangements usually employed in arc lamps. The piece *e*

traverses, before entering and after leaving the furnace, proper-suitable tubes *p* in which it is prepared on the one hand for the action of the furnace by passage through the special gas therein contained, and on the other cooled before passing through the stuffing-box by which it leaves. The working of the apparatus is absolutely continuous, since a constant successian of bars or rods may be passed through it. In the figure the object to be heated is shown undergoing the action of a single arc, but generally the object to be heated serves as a common electrode to two arcs in succession. The movement of translation is given to the piece of work by means of rollers actuated by an electric motor.

When it is desired to pass pulverulent material capable or not of being fused, the piece *e* may consist of a tube, closed at either end and containing the material to be treated. The cylinder moves across the furnace in the manner already described, and is made of some material capable of withstanding the temperature it is called upon to resist. Instead of circulating with its recipient or crucible the substance to be treated may instead be set in motion inside the containing vessel, which may then be kept fixed. In this case we employ the arrangement shown in Fig. 20, where the heating chamber consists of a carbon tube *r*, which is at the same time a crucible and an electrode for the arc. The heat is then obtained from two arcs in series or from several groups of arcs two in series. When the material, after its passage through the heating chamber or crucible *r*, is capable of fusion, the pattern shown in Fig. 21 is adopted, in which there is an outlet *z* so arranged that, notwithstanding this orifice, the special gases can be kept in the furnace.

It is sometimes an advantage to spread the action of the electric arc more evenly over the material to be treated. To attain this end we cause the arc to rotate within the furnace by bringing a suitable magnetic field to bear upon it. Let us take, for instance, the treatment of bars, rods and wires just described. The rod or bar *e* (Fig. 22) undergoing treatment passes through a

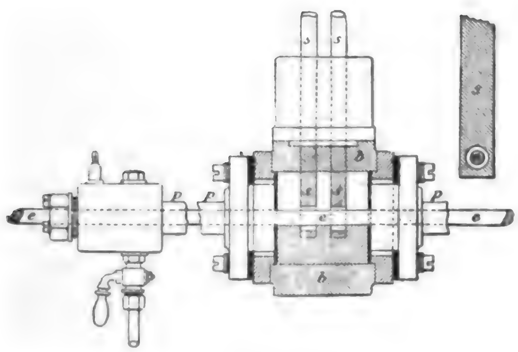


FIG. 22.

succession of carbons *s*, the ends of which are pierced, as shown, with holes concentric with the axis of the rod or bar *e*. The arc is struck between *e* and the carbons *s* at a certain point by drawing the carbons through their stuffing boxes until they come into contact with *e*. Upon this element of current we bring a perpendicular magnetic field to bear by winding the outside of the furnace with coils traversed by an electric current, the metal cover *b* being in this case of non-magnetic material. Under the influence of this field the arc rotates in a plane at right angles to the bar *e*, and thus touches it at every point on its circumference. The speed of rotation of the arc is a function of the magnetic field in which it is placed and the strength of the current passing through the arc. The principle of the rotating arc is applicable to the different patterns of furnace we have devised. The combination of the rotary movement of the arc with the translatory movement of the bar to be heated results in the arc touching every point of the surface of the piece, and there is consequently a perfectly symmetrical distribution of heat.

THE STORAGE BATTERY IN TELEGRAPHY.

About a year ago, the Stock Quotation Telegraph Company of New York installed at its Broad street offices a battery of 100 Chloride accumulators for use in operating its tickers. The improved service, the increased economy and the element of safety in always having a reserve supply of current, have now led the Company to install in its Baltimore office a battery plant of 120 Chloride accumulators, which will be used to operate the tickers in that city.

Portable batteries of Chloride accumulators were used in reporting the International Yacht races from Atlantic Highlands by the Western Union Telegraph Company, operating the Edison phonoplex; and from the Highlands of Navesink by the Postal Telegraph Cable Company, operating quadruplex locals.

SOCIETY AND CLUB NOTES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

AT the regular monthly meeting of Council, held at the rooms of the Institute, Sept. 25th, the following associate members were elected: Sydney B. Austin, Student in Electrical Engineering, Cornell University; residence, Sidney, N. Y.; Geo. H. Blaxter, Vice-President and General Manager, Allegheny County Light Co., Westinghouse Building, Pittsburg, Pa.; Elmer E. Boyer, Electrical Engineer, The Gen'l Electric Co., Lynn, Mass.; Byron T. Burt, Manager and Sec'y and Treas. Charleston Light and Power Co., Charleston, S. C.; Henry S. Carhart, Prof. of Physics in University of Michigan, Ann Arbor, Mich.; John B. Cornell, Supt. of Construction with Chas. L. Cornell, Hamilton, O.; Maurice Coster, Engineer Westinghouse Elec. and Mfg. Co., N. Y. Life Building, Chicago, Ill.; David Francis Crawford, Ass't to Supt. Motive Power, Penn'a Co., Fort Wayne, Ind; Philip Dawson, Associate and Chief Engineer, with R. W. Blackwell, 39 Victoria Street, Westminster, London, Eng.; Lewis Degan, Constructing Engineer, Gen'l Electric Co., Rio de Janeiro, Brazil; Will Knox Dunlap, Electrical Engineer, Westinghouse Elec. and Mfg. Co., Pittsburg, Pa.; Thomas C. Frenyear, Gen'l Manager, Cayadutta Elec. Railway Co., Gloversville, N. Y.; Carl Harold Hakonson, Assistant Engineer, Gen'l Electric Co., P. O. Box 254, Schenectady, N. Y.; Russell B. Harrison, Pres. and Electrical Engineer, Terre Haute Electrical R'way Co., Terre Haute, Ind.; Robert T. Harvey, 10 So. Franklin Street, Wilkesbarre, Pa.; Chas. E. Hewitt, Graduate Student in Electrical Engineering, Cornell University, residence Hanover, N. H.; Chas. R. Huntley, General Manager, Buffalo Gen'l Electric Co., 40 Court Street, Buffalo, N. Y.; D. W. Irvine, Student in Electrical Engineering Lehigh University, So. Bethlehem, Pa., residence, Chambersburg, Pa.; Wallace W. Ker, Instructor of Electricity, Hebrew Technical Institute, 36 Stuyvesant Street, New York City, residence, 48 Waverly Street, Jersey City, N. J.; Paul M. Lincoln, Electrician-in-charge, Cataract Construction Co., Niagara Falls, N. Y.; Robt. Bruce Mann, 643 Franklin Street, Milwaukee, Wis.; Josiah L. Merrill, Ass't to Estimating Engineer of the Construction Department, Gen'l Elec. Co., Schenectady, N. Y.; Chas. H. Merz, with Messrs. Robey & Co., 38 Portland Street, Lincoln, Eng.; residence, The Quarries, Newcastle-on-Tyne, England; James Mitchell, Constructing Engineer and Agent, General Electric Co., Rio de Janeiro, Brazil; Edgar L. Morley, Superintendent Hatzel & Buehler, 114 5th Avenue, residence, 107 Lexington Avenue, New York City; Evan Parry, Engineer, The British Thomson-Houston, Ltd., 52 Glengarry Road, East Dulwich, London, S. E.; Andrew Pinkerton, Electrical Engineer, The Apollo Iron and Steel Co., Apollo, Pa.; Percy Howard Powell, Cornell University, Class of '95, residence, Hempstead, N. Y.; Dwight Parker Robinson, with Stone & Webster, Boston, Mass., residence, 100 Washington Street, Chicago, Ill.; David B. Rushmore, Student in Electrical Engineering, Cornell University, residence, 168 Grove Street, Plainfield, N. J.; John F. Skirrow, Ass't Manager, Postal Telegraph Cable Co., N. Y. City, residence, 703 President Street, Brooklyn, N. Y.; Henry G. Stott, Electrical Engineer, Buffalo Gen'l Electric Co., Buffalo, N. Y.; Gustav Adolph Wiese, City Electrician of Alameda, 718 Haight Ave., Alameda, Cal.; Chester P. Wilson, Sup't 33d and Market Sts. Power Station, Philadelphia Traction Co., residence, 348 N. 41st Street, Philadelphia, Pa.

Prof. F. A. C. Perrine of Leland Stanford Junior University, Palo Alto, was appointed Local Secretary for San Francisco and vicinity.

In order to provide a more central location for the meetings of Western members at Chicago, the report of the Committee appointed at the Niagara Falls Meeting to consider this question, was taken up, and the use of the rooms of the Western Society of Engineers in the Monadnock Building was authorized for the present season, as recommended by the Committee.

Through the courtesy of the Armour Institute meetings requiring the use of apparatus will be held there as heretofore.

The meeting of the Institute in the evening was held at the Hoffman House, a paper by Mr. C. S. Bradley on "Phasing Transformers" being read by the author and the working of the described apparatus shown. Eighty members were present, and were entertained by Mr. Bradley after the meeting with refreshments.

OHIO ELECTRIC LIGHT ASSOCIATION.

The annual meeting of the Ohio Electric Light Association will be held at Piqua, Ohio, on Tuesday, October 8, 1895. Arrangements have been made with the Hotel Plaza for the accommodation at reasonable rates of all attending. The first session will be held at the Hotel at 2 p. m. Standard time. Mr. A. W. Field, the president of the Association, is secretary and manager of the Columbus, O., Electric Light Co.

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CONTENTS.

"PUT YOUR MOUTH CLOSER."

ONE of the familiar injunctions received, when telephoning, from "Central" or the other end of the telephone line, is to "Put your mouth closer." This usually secures better results in a telephonic conversation than raising the voice, which is also objectionable unless your office is provided with a telephone cabinet. But it appears that in some places strenuous objection is being raised to such a practice on the score of health. The Chicago Telephone Co. placed recently a notice on each of its transmitters, asking the users to put their lips directly within the instrument, but the Commissioner of Health has now insisted that the Company shall "immediately cause the removal of this filthy and disease-breeding instruction."

The situation is an interesting one. The commissioner assumes that to be a fact which we have never yet seen a single proof of, viz., that the telephone propagates disease waves as well as sound waves. Some time ago the newspapers in New York amused themselves by serving up alleged microscopic exhibits of telephone diaphragms, seen like platters with an olla podrida of food and other things supposed to have come from the mouth of the users. But even then not one case of infection was named. The scare is something like the periodic one of the same nature in regard to books from public libraries, although, for example, the Boston Public Library circulates more than 2,000,000 volumes a year but in 43 years has not been able to establish a single case of conveyance of disease by its books. Of course books not clean, or found to come from centres of infection, are destroyed; and we imagine that any self respecting office would at least polish up its telephone daily just as it does its washbowls or cuspidors. It is plausible also to urge that very few people loaded with disease go wandering around using private telephones promiscuously. They usually stay home.

We believe that in Chicago, the old Blake transmitter is still largely used, the people not yet showing such general preference for the newer "long distance" transmitter as do the inhabitants of many other cities. This being so, it is natural that the Chicago management, which is one of the most efficient in the country, should try to get better talking for its customers by the use of such placards, the Blake needing, like a pretty girl, quite a close application of the lips. We would venture to suggest that the Commissioner of Health allow the notice to stay up and add one of his own, advising the public to clean its mouth and its telephones more frequently.

ELECTRICAL FIRES.

Electric lighting and electrical distribution generally, besides the direct influence which it has exercised in the directions where the current is actually utilized, has impressed its effects on numerous collateral branches in the business world, and among these we doubt whether any has been more influenced than that of fire insurance. Looking back over a period of fifteen years and contemplating the apparatus and devices employed in the earlier stages of the art, it does not strike us a matter of surprise that the fire underwriters were so emphatic in their demands for better construction; indeed we are almost inclined to credit them with leniency. The last five years, however, thanks to the demands of the fire underwriters and not less to the influence of the National Electric Light Association—whose installation rules constitute the

foundation for practically all the rules of the boards of fire underwriters throughout the country,—there has been brought about a marked improvement, both in means and in methods, among the latter of which perhaps none has contributed more to safety and progress than the interior conduit. But unfortunately the art is still suffering from the errors of the past and as long as electricity is still credited with the fire losses attributed to it by the reports of the underwriters, it behooves those interested in the welfare of the industry to apply the remedies which experience suggests. The condition of affairs in this respect is well presented in a paper read by Mr. E. A. Merrill, electrician of the electrical bureau of the National Board of Underwriters at the Fire Underwriters' Convention in Chicago, last week. To begin with, Mr. Merrill asserts that the electrical fire loss to the insurance companies may be anywhere from $3,000,000 to $5,000,000 annually, while it is proved that $1,500,000 can be directly traced to that origin. The readiness which the underwriters have shown to attribute fires of obscure origin to electricity whenever a wire happened to be in or near a burnt building, would make us look with suspicion on the first figures, but taking the latter figure to be correct, though large in the aggregate, it is small, and insignificant, as compared with losses due to gas, kerosene and matches, and as compared with other systems of power distribution. Nevertheless the underwriters have a right to demand, and the electrical industry ought to seek, the reduction of this loss by every means available. As to the causes of electrical fires, Mr. Merrill's analysis shows that over one-seventh of the losses were due to the crossing of telephone, telegraph and similar wires with trolley or electric light wires.

The obvious remedy to avoid such crosses, is as Mr. Merrill suggests, to bury all aerial wires. Nothing, indeed, could be more simple, but unfortunately electric railway conduit systems are expensive, as are likewise electric light conduits, and while we do not hesitate to affirm that both systems will be found more economical in the long run in the majority of cases, the desire of the stockholder for present dividends is greater than that for steady profits to his heirs in the future. Thus, although the radical measure proposed by Mr. Merrill would be most effective, its present accomplishment is practically impossible. But is there not some medium path which would accomplish the object aimed at in a less expensive manner? We believe there is, and would suggest that the desired result could be reached by burying one type of conductor at each crossing. In the case of a line of telephone wires crossing a trolley line, the former could be gathered into a cable, run down the pole and under the street to the opposite side of the railway wire and up the pole again, and then branch out once more into an aerial circuit; the whole constituting in effect an underground cable crossing. It may be argued that this plan would work well enough in the case of a line carrying a dozen wires or more, but that it hardly covers the case of the single lines cutting across blocks on house tops, which usually give the most trouble. Even in such cases it seems to us feasible to employ the underground loop at crossings with high tension wires, but a heavier aerial construction than is now employed at such points would itself go far towards attaining the object aimed at.

Next to the "crossing," Mr. Merrill finds the wooden base devices to be the most fruitful source of trouble, and one-twelfth of the total fire loss is put to their credit, or rather discredit. It is safe to say, that wooden bases are things of the past and that a few years hence they will only be met with in museums of electrical apparatus. Mr. Merrill admits that the manufacture of wooden base devices has been practically abandoned and that the losses now experienced from them are due to such as were installed years ago, when their dangerous qualities were not recognized.

We must commend the good work being done by the National Board of Fire Underwriters, under the supervision of Mr. Merrill and others, in the publication and distribution of detailed reports of fires of electrical origin, which reports are made still more valuable by the reproduction of photographs of the fire-causing devices. These constitute most excellent object lessons. Of course, no rules or regulations can be made to cover the case of the countryman who, after vainly trying to blow out an incandescent lamp, finally secured darkness by wrapping a towel about the lamp, and a couple of hours later was dragged out of his room half suffocated by smoke; but, with intelligent inspectors in their service and the ever-increasing intelligence of the public in all matters pertaining to electricity, improvement in the safety of electrical installations is bound to follow.

SPANISH SHIP WIRING.

A Spanish man-of-war was run down last week at Havana with great loss of life. After the collision became inevitable and in the excitement and rush, "a fireman stumbled against the electric wires supplying light and displaced them, and in an instant, total darkness enveloped the ship. * * * Under such circumstances the ship was doomed." We should think it would be. The wiring of a man-of-war which in a critical emergency can be kicked asunder by a clumsy or rattled fireman would certainly cause or intensify a calamity sooner or later. We wish we could persuade ourselves that such abominable work were confined to Spanish ships of war; but we can't. The opportunities for improvement in all electrical work afloat are very numerous and extensive.

BRAKES ON TROLLEY CARS.

In commending recently the efforts of THE ELECTRICAL ENGINEER to secure the adoption of quick-acting brakes on trolley cars, our esteemed contemporary, the *American Machinist*, after quoting several of our remarks and arguments on the subject, says:—

> Can any one who understands the situation claim that in the above is *the whole truth* about the brake on the trolley car? Certainly swift-running cars should have quick-acting brakes. It is not telling us much to tell us that. But is it true or is it untrue, is it acknowledged or is it denied that, as we asserted, "an electrically driven car, upon a street railway, a trolley car, either an overhead trolley or an underground trolley, and especially, and for an additional reason, a car operated by a storage battery, cannot, either of them, *with safety to itself*, be stopped as quickly as any other car of the same capacity and running at the same speed?" Is it true or is it not true that electric cars are purposely equipped with slow-acting brakes, and that human lives are being sacrificed for the safety of the motor mechanism?

We wish to say that it is untrue. We desire to deny the existence of any such state of things. We affirm positively, flatly, absolutely and finally that the facts are wholly otherwise. We never saw even the idea mentioned until our friends propounded it. We have been associated with the electric railway industry very actively ever since there was a street car run by current of any kind, and we have never known, and have never met, and have never heard of, an electrical engineer who objected to air brakes, or quick brakes of any kind because of danger to the motor mechanism. If our contemporary would like this stated more strongly, we shall be glad to oblige it in that way; and we insist once more that *all electric cars ought to have air brakes.*

ELECTRIC TRANSPORTATION DEPARTMENT.

THE ACME STORAGE BATTERY CAR.

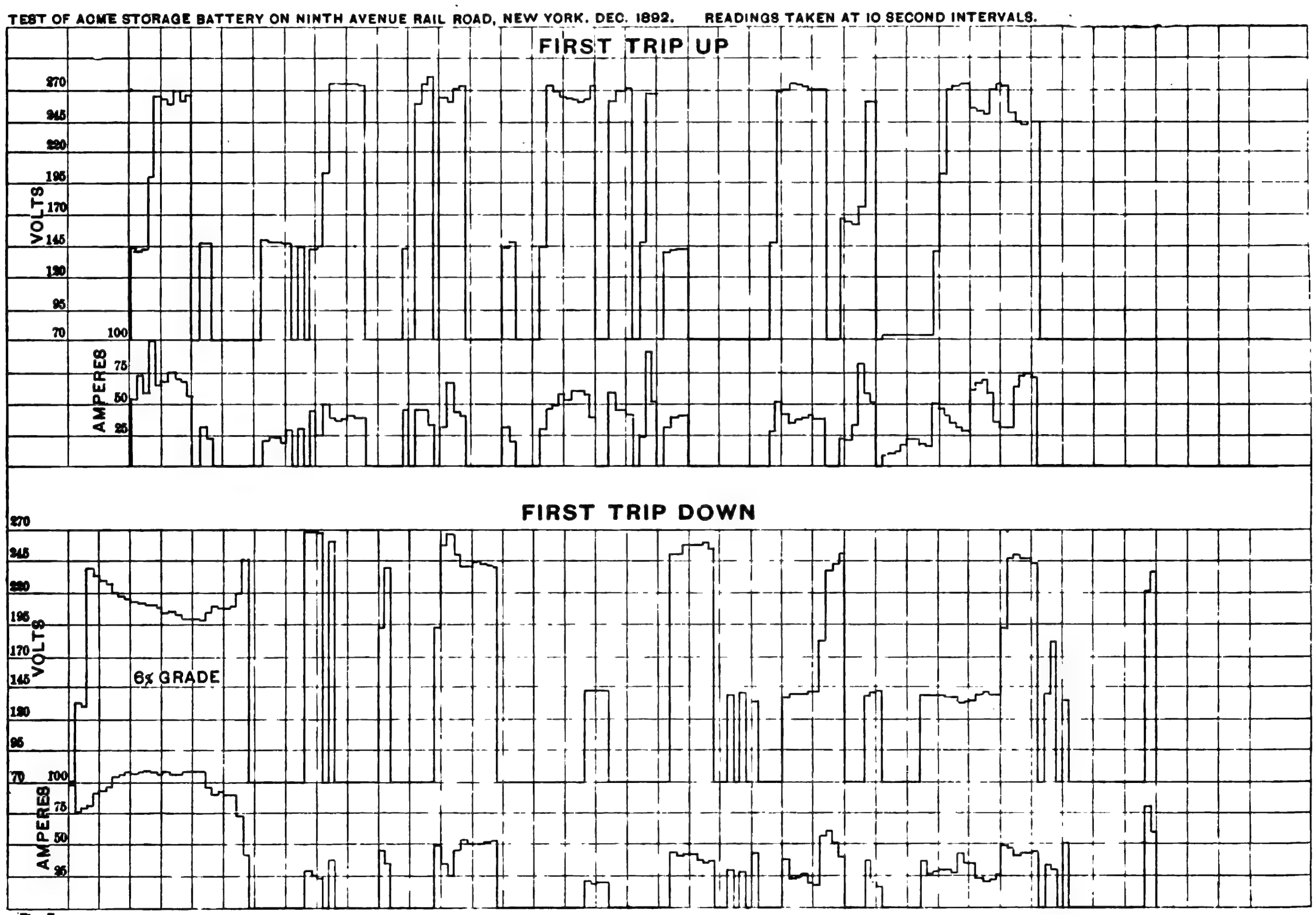
The great interest which is manifested at the present time, in the horseless vehicle, adds to the demand for a storage battery that is fit for traction purposes. Such a battery is the one of which the record is given in the accompanying diagrams. This battery was known as the Acme, and was described in our issue of September 28, 1892. The record here given was made in the December following. Although the results obtained, such as attaining a speed of seven and a half miles an hour ascending a six per cent. grade, were quite gratifying, and certainly compared well with other battery work, the battery has nevertheless been improved since that time.

The battery is in the hands of a number of business men of the highest standing, and will be backed by ample capital for projecting both traction and stationary work. In its improved form this battery is manufactured by a process which includes the Planté disintegration and formation, and which produces plates of greater capacity and durability than the "filled" plates originally used, and which did such good work. It will be seen by reference to the diagram, that the current reached a maximum of 109 amperes on one trip up the steep grade and averaged for the whole grade 98.19 amperes. This is the kind of work that best illustrates the quality of a battery. The average energy required to propel the car was 1.07 horse power hours per car mile for the round trip from the stables at 53rd St. and Ninth Ave., to Manhattan St. and Amsterdam Ave., and return. Between the stable and 117th St. it was only .8 horse power hour per car mile. This is about equal to a good trolley car of the same size, and effectually refutes the somewhat common belief that the weight of a storage battery is so great as to materially increase the power required to propel a given car.

This point was noticed in our issue of Sept. 18, in the very able article on "Accumulator Traction" by Mr. Maurice Barnett. To be sure the Acme battery is considerably lighter than most other batteries of the same capacity, weighing 27 pounds per cell where a lead grid cell of the same capacity weighs 40 pounds. But even then there is considerable weight to carry and the fact that the car runs so easily shows that the efficiency of the dynamo machinery is high. This may be attribued to the fact that the nature of the power (that is a number of cells which may be grouped in different ways) allows the designing of motors of very high average efficiency, so as to practically neutralize the effect of the extra weight above that of a trolley car of the same dimensions.

The speed attained on a level track was twelve miles per hour, which is ample for city work. A greater speed could be easily attained if desired but the motor was designed purposely for speeds that are allowed in New York City. The average speed up the hill before mentioned, is 7 miles per hour and the average horse power on this hill about 28, or at the rate of 4 horse power hours per car mile, which is 4 times the average for the round trip. This amount of power was furnished by the batteries in a most satisfactory manner, the voltage recovering immediately when the top of the hill was reached.

One of the most important qualifications of a battery for traction work is of course that it should deliver current freely, giving discharges for short periods, of several times the average rate, not only without injury to the plates, but with a minimum drop of voltage, and the Acme battery appears to excel in this particular. A car will be in operation in a short time in this city, equipped with the improved form of this battery, and will run over the St. Nicholas Ave. line. Mr. Barnett in the article above referred to estimates the cost of running battery cars to be practically the same as trolley cars. In the paper of Mr. Jules Sarcia mentioned by Mr. Barnett, one estimate is made as low as 10.88



Test of Acme Storage Battery on Ninth Ave. Railroad, New York, Dec., 1892. Readings Taken at 10 Second Intervals.

cents per car mile, and in the paper of Mr. P. Van Volten in the *Bulletin de la Société Belge d'Electriciens*, for Jan., Feb. and March, the estimates of cost of two battery roads are less than those for some of the trolley roads given.

THE LA BURT ELECTRIC RAILWAY CONDUIT.

The recent developments in the the field of electric railways operated by "underground trolley" have given considerable stimulus to work in that branch of locomotion, and with promising results. It will have been noticed that much of the work for which success is claimed is done with the deep conduit of the ordinary cable type, placed centrally between the tracks, with very heavy substructure and with the whole conductor system always in circuit. Many inventors believe, however, that this is by no means necessary, but that the desired end can be attained by means of a shallow conduit, by a line divided up into sections and by a conduit which is more or less sealed. An ingenious method proposed and experimentally introduced embodying all these highly desirable features is that of Mr. John La Burt, represented by the La Burt Electric Railway Co. of 128 Liberty street, New York City. The two clear cuts shown herewith render little explanation necessary. The conduit is 13" deep and consists essentially of a slotted rail, in the chamber of which a two-wheel upward pressing trolley moves, attached to the car. This trolley in its forward or backward movement when the car travels lifts a rod which is in short sections, and which connects at junction or switch boxes 16" x 16". At these boxes, the rod as lifted swings a plunger or rock lever into contact with a cup receptacle or plug socket which in turn connects with the main feeders of the line. This contacting device is enclosed within a small air tight box, 4" x 6", impervious to moisture. As soon as the car leaves one section and passes to another, the trolley rod falls back to its supports, the contact device opens, and the section behind the car is left "dead." The only time the sections are "alive" is when the car lifts the rod and passes over them. As contact is made on the one section before it is broken on the other, the sparking of the contacts is reduced to a minimum, if not entirely eliminated. Under the trolley, on a prolongation of the stem, is a sweeper for keeping the shallow conduit clean. Access is readily obtained to the conduit through the switch boxes, which are at such short intervals that inspection or renewal of any part is easy and swift. Mr. La Burt states that this conduit can be built at from $10,000 to $15,000 per mile, according to the conditions and requirements; and that in no case can its cost at all approach that of the deep open slot conduit system with continuous conductors.

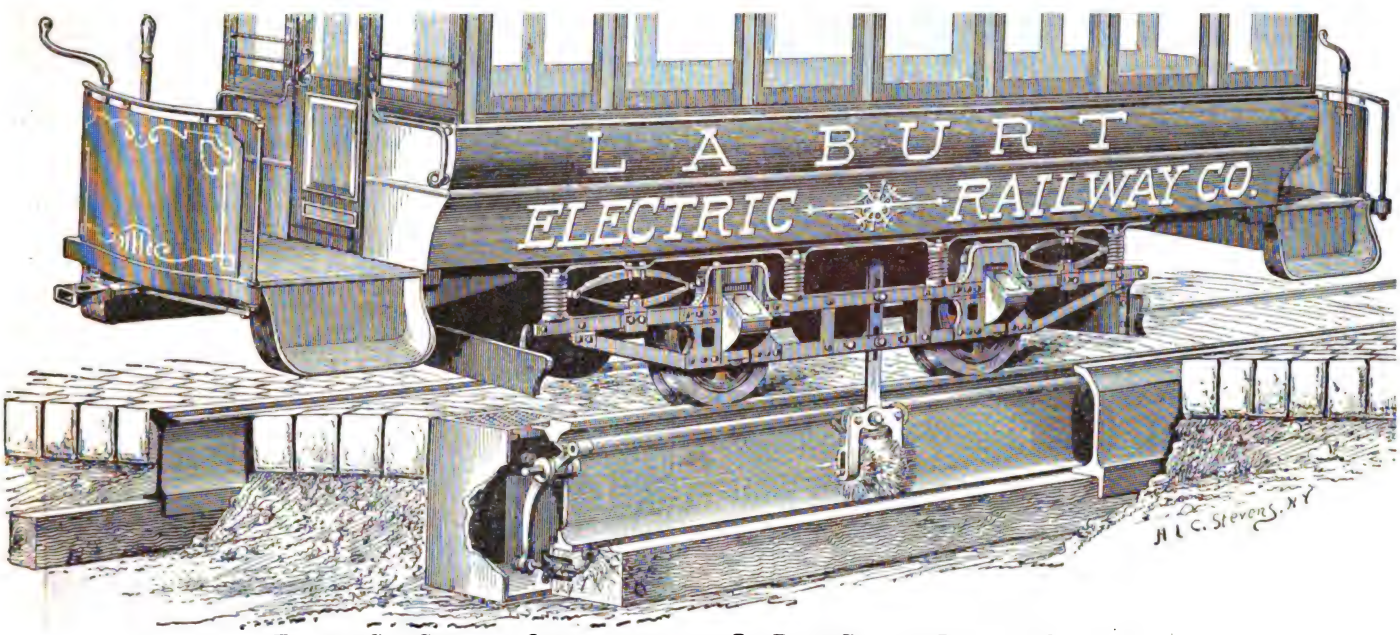


FIG. 2.—CAR SHOWING OPERATION OF THE LA BURT CONDUIT RAILWAY SYSTEM.

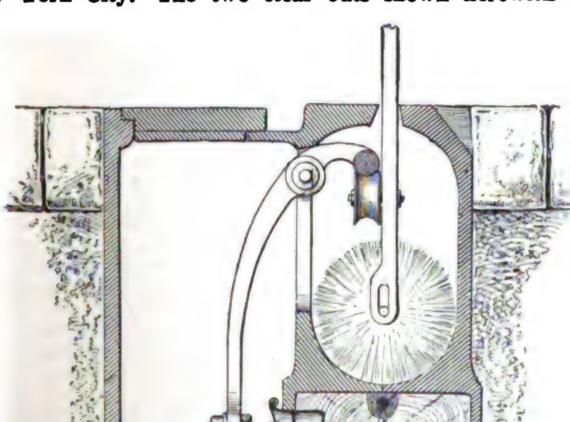


FIG. 1.—CONTACT BOX, LA BURT CONDUIT RAILWAY.

NASSAU TO CROSS THE LONG ISLAND STEAM TRACKS.

THE fight which has been going on for some time between the Long Island Railroad and the Nassau Electric Railroad over their crossing at Ocean Avenue was ended last week by Supreme Court Justice Pratt, in Brooklyn, in favor of the Nassau Electric Railroad. Justice Pratt issued a temporary injunction restraining the Long Island and Manhattan Beach Railroads from interfering with the electric road's crossing at the point named. The temporary injunction practically permits the electric surface road, of which Patrick H. Flynn is president, to build a crossing over the steam road, and thus complete its Manhattan Beach route. There was a heavy traffic over the trolley road Sunday, and the surface cars bumped as best they could across the rails of the steam road. The fare from Brooklyn to Manhattan Beach by trolley is only 5 cents—one of the cheapest rides in the country, and a great boon to Brooklynites in hot weather.

MICHIGAN ASSOCIATION OF STREET RAILWAY MANAGERS.

THE Michigan Association of Street Railway Managers met in annual session at Grand Rapids on Sept. 18. The morning was largely consumed by an inspection of the power-house plant and an extended ride over the many miles of service operated by the Consolidated Street railway company. The objects of the association are to promote and further the best interests of the different street railways of the state, and, as one member expressed it, "to prepare ourselves to be able to carry the most people the longest distance in the shortest time for the least amount of money."

Among the members present were: W. Worth Bean, St Joe; Frank Huntoon and G. A. Hart, Manistee; A. L. Dixon and W. L. Jenks, Port Huron; J. P. Lee, Lansing; F. N. Rowley, Kalamazoo; L. N. Davis, Kalamazoo; E. F. Erwin and Fred Nims, Muskegon. The association was banqueted at the Lakeside Club.

JACKSONVILLE, FLA.—The Jacksonville Street Railroad Co. is going into the business of supplying current for electric light and power. There is another station in town and the city runs a plant.

THE BUFFALO AND NIAGARA FALLS ELECTRIC RAILWAY.

Charter, Franchise and Capitalization:—The Buffalo and Niagara Falls Electric Railway results from a recent consolidation of the former corporation of the same name with the Buffalo and Tonawanda Electric Railway. The present Buffalo and Niagara Falls Electric Railway has just completed a double track railway

TRACK CONSTRUCTION, BUFFALO AND NIAGARA FALLS RAILROAD.

from the Buffalo city line to the city line of Niagara Falls, which was opened for business last week.

The Company has a paid-up capital stock of $1,250,000, and bond indebtedness of $750,000. A portion of the bonds and stock will remain in the treasury after the completion of the present line, to be used for improvements and extension.

Officers of the Company:—The President of the Company is the Hon. W. Caryl Ely, an attorney and ex-State Senator. Much of the credit of the organization belongs to Mr. Ely, as the franchise and charter were obtained by him during the recent financial stringency, by his energy and perseverance. The Vice-President of the Company is Mr. Burt Van Horn, of Niagara Falls; Secretary and Treasurer, Mr. George H. Dunbar, of

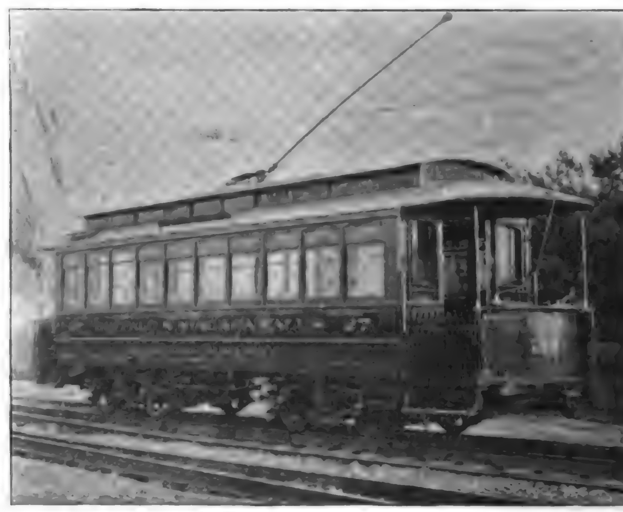
POWER HOUSE, BUFFALO & NIAGARA FALLS, RAILROAD.

Buffalo. Among the Directors of the Company, are the well-known railway and business men: H. H. Littell, General Manager, Buffalo Railway Company; H. M. Watson, President of the Buffalo Railway; Captain Gaskill, President of the Niagara Falls and Suspension Bridge Electric Railway; Robert L. Fryer, Vice-President of the Buffalo Railway; H. J. Pierce, President of the Manhattan Spirit Company.

Traffic Arrangements:—The Buffalo and Niagara Falls Electric Railway has an exclusive traffic arrangment with the Buffalo Railway Co. for Niagara Falls traffic for a period of fifty years and with the Niagara Falls and Suspension Bridge Electric Railway for Buffalo traffic for a period of thirty-five years. The company has just completed a double track line joining the above mentioned railways, extending from the city line of Buffalo to the city line of Niagara Falls, a distance of fourteen and one-half miles, and passes through the villages of Tonawanda, North Tonawanda and Lazalle. The company charges a fifty cent fare for round trip from Buffalo to Niagara Falls, including transfer over the electric railways both in Buffalo and Niagara Falls, so that it will be possible to go from any point on the system of the Buffalo Railway to any point in Niagara Falls and return for fifty cents. Cars will be run through from Main street in Buffalo to the State Reservation at Niagara Falls, and the excursion business during the summer months from the three hundred thousand people living in Buffalo should be very large. Besides this the Company will derive a revenue from twenty thousand inhabitants in Tonawanda and North Tonawanda, and about an equal number in Niagara Falls, in addition to a considerable excursion traffic from visitors at Niagara Falls, who may wish to visit Buffalo.

Track:—The track construction is of the most substantial kind, and railway men who have recently been over the road are unanimous in the opinion, that there is nowhere in the United States a line of twenty-nine miles of single track which is equal to the track owned by this company. The track is laid with 73 pound girder rail of such section that it is almost equivalent to Tee rail.

This rail has been laid in sixty foot lengths upon white oak ties eight feet long, 6" thick and 9" wide. These ties are placed



STANDARD CAR, BUFFALO AND NIAGARA FALLS RAILROAD.

two feet between centres, and the track for its entire length is ballasted under the ties, two feet outside and between the tracks with crushed stone. Stone ballast is 18" deep over the entire line, extending from 5" under the ties to the top of the rails which are 7" high. The rails are prevented from spreading by heavy brace tie plates placed six feet apart, and the joints, of which there are only one-half the usual number, are held in place by very heavy angle bars, 36" long and secured by eight bolts of 1" diameter. The bonding throughout has been done with two No. 000 Chicago bonds, besides which the four rails are cross bonded at frequent intervals. The straight track throughout is furnished by the Cambria Iron Company. Most of the special work was furnished by the Pennsylvania Steel Company, although the crossings over two electric and two steam railroads were furnished by the Johnson Company.

Overhead Crossing:—There are no particular features of interest in the overhead construction. Wooden poles have been used throughout, round cedar, 8" at the top being used for about one half of the length of the line and octagonal Georgia pine for the remainder of the route. Span construction has been used throughout with No. 0 trolley wire. Some forty miles of No. 0000 feeder has been erected on the three sections into which the overhead work has been divided.

Power:—The company expects ultimately to take power from the Cataract Construction Company for the entire line. The Cataract Construction Company will furnish power for the section nearest Niagara Falls only, which includes about five miles of double track. For supplying the rest of the line with power, a steam plant has been installed, comprising four 125 horse power return tubular boilers, built for high pressure by the Phoenix Iron Works; two compound condensing Ball engines and two H. P. 200

multipolar generators, furnished by the General Electric Company. This plant has been housed in a brick building, with steel trusses and corrugated iron roof, and is substantial throughout.

Cars and Equipments:—The company owns and is now operating twenty motor cars, including trucks, built by the J. G. Brill Company, twenty-eight feet long inside and thirty-six feet long over all, each equipped with four G. E. 800 motors. By special switch, these motors can be operated all in series, or in multiple series or all in multiple, and these combinations with varying amounts

Car House, Exterior, Buffalo and Niagara Falls Railroad.

of resistance in the armature circuits or shunting fields gives a wide range of speed. With motors all in multiple, a speed of forty miles per hour has frequently been reached, and the Company is now operating its cars daily over a practically straight and unobstructed portion of its road over three miles long at a speed exceeding thirty miles per hour. The road is also to draw current from the Niagara Falls electric power plant, by rotary transformers running two in series, of 220 volts each.

Steam Railroad Crossings:—This road crosses at grade, in North Tonawanda, the Lockport branches of the New York Central and Erie Railways. In order to avoid grade crossings over the main line of these roads in the same town, the Company is now expending some $30,000. Both of these roads will be crossed by a single through span pin-connected bridge, 171 feet long, and the public highway will be crossed by two plate girder spans. These steel spans are reached by trestles built of yellow pine, in accordance with general steam railway bridge practice; one of them having a 75 foot radius curve and a grade of 7 per cent., the other having a practically slight curve and grade of 4½ per cent.

Commencement of Operation:—On Thursday, September 19th, the first car passed over the line. On Friday, the 20th, about one thousand invited guests were carried from Buffalo to Niagara Falls and return, and on Saturday, September 21st, the use of the road was given to the Press Club of Buffalo, for an excursion of about fifteen hundred people, the entire proceeds of sale of tickets being for the benefit of the Press Club. On Sunday,

Car House Interior.—Buffalo & Niagara Falls Railroad.

September 22d, the road was opened for public travel, and without any more serious accidents than a few hot journals and a few broken trolley poles. During this day the cars were taxed to their utmost capacity and many thousands of people along the line were unable to get transportation. The road should do a large business from the city and as the territory between Buffalo and Niagara Falls grows up the property should enhance in value with rapid strides.

Construction Contract:—The contract for the entire construction and equipment of the road was let to the White-Crosby Company of New York early in the present year. On account of the very severe and late snow of last winter the construction could not be begun until May 10. The contract of the White-Crosby Company not only included the furnishing of all material, such as ties, rail, ballast, etc., entering into the construction, but the White-Crosby Company also accepted a considerable portion of their contract in bonds and stock of the Buffalo and Niagara Falls Electric Railway. It is learned on good authority that these bonds have all been sold direct, and without the assistance of any brokers or financial agents.

THE SNAEFELL MOUNTAIN RAILWAY.

This railway, on the Isle of Man, commences at the village of Laxey, seven miles from Douglas, and terminates on the summit of Snaefell, at a height of 2,000 ft. above sea level. The total length of the line is 4¾ miles. The actual height ascended is 1,820 ft., making the ruling gradient 1 in 12. The gauge is 3 ft. 6 in., and the line is double throughout the entire length. The carrying rails are of steel, and weigh 50 lbs. to the yard. A centre rail, known as the "Fell System," has been adopted to ensure absolute safety to the descending trains. It is a double-headed rail, weighing 65 lbs. to the yard. The rail is carried on wrought-steel chairs, to which it is bolted. The chairs are fastened to the cross sleepers by four fang bolts, a chair being placed on every sleeper. The Fell system is also utilized for tractive purposes as well as for brake power. Horizontal wheels are driven by a separate motor, enabling heavier loads to be carried at a greater speed on steep inclines. This system was applied to the crossing of the Mont Cenis Pass of the Alps before the great tunnel was completed, and it has been successfully working in South America, and has also been adopted by the New Zealand Government for crossing mountain ranges. The whole of the plant has been designed and constructed by Messrs. Mather and Platt, Limited, of Manchester. There are four Lancashire boilers, each 26 ft. long and 6 ft. 6 in. in diameter, working at 120 lbs. pressure per square inch, and capable of giving steam sufficient for 700 H P. There are five compound horizontal engines, and each independently drives a Mather and Platt dynamo. The dynamos supply the current at 500 volts pressure. The generating plant is erected in a station close to the line, about 2¾ miles from the Laxey terminus. At the latter place there is also a large accumulator station containing 246 cells of the Chloride type. The accumulators absorb the spare current generated by the dynamos and distribute it to the line as the load requires. Messrs. Mather and Platt first introduced this system on the Douglas and Laxey Electric Tramway (already described in The Electrical Engineer), where it has proved a great success, contributing largely to the economical and regular working of the line. It has also been adopted by them on the Stockholm and Djarsholm Electric Railway. The passenger cars are 35 ft. in length, and will seat 48 passengers. The seats, which have movable backs, are placed transversely, so that the passengers may face the direction in which they are travelling. Each car is carried on two four-wheeled bogies. Each axle is driven by a Mather and Platt motor, capable of driving the car at a speed of eight or nine miles an hour on the ascending grade. Absolute safety is obtained against the cars leaving the rails. It would be an impossibility for the flanges of the carrying wheels to mount the bearing rail whilst the guide wheels are in play. A powerful centre-rail brake is fitted to each car, the action of which is to grip the centre rail itself. Whatever speed may be obtained in descending, no danger can possibly arise, as the car can be stopped within a few seconds from the brake being applied.

DISTINGUISHING LIGHTS FOR THE HARTFORD, CONN., TROLLEY CARS.

The Hartford street railway company is experimenting with various plans for a complete system of colored designating lights to be used on the cars at night.

It is proposed to have lights on each of the four corners of the car roof, each lantern showing lights at both the side and the end. The lanterns are of tin, blackened, eight inches high and about six inches square, with two reflectors, side and end. The lights are electric. About fifteen of the box cars have already been fitted with these lanterns, and others will be fitted as fast as the lanterns can be procured. There will be some trouble in selecting, for all the different lines of the road, different colored lights which shall be so different from each other that patrons may not be confused. It is probable, however, that the old familiar colors of the cars will be preserved, as far as possible, such as red for the Main street line, blue for the Albany Avenue, etc., but it is evident that, as the list of colored lights readily distinguishable at a distance is somewhat limited, there may be some difficulty in selecting lights for all the lines, which shall be entirely satisfactory.

HOW SHALL WE HEAT CARS?—II.

BY J. F. MC ELROY.

This throttling action of the electric heaters with iron resisting conductors is best illustrated in Fig. 1., which shows the principle which we have just been discussing, applied to electric heaters. The upper curve is a curve of temperature obtained from a thermometer placed within the porcelain insulator itself. The two lower curves of temperature were obtained by two thermometers placed within the heater casings and about one-half an inch above the coils of the heater proper. An idea of the rise of the temperature of the air in the upper part of the heater casing may be

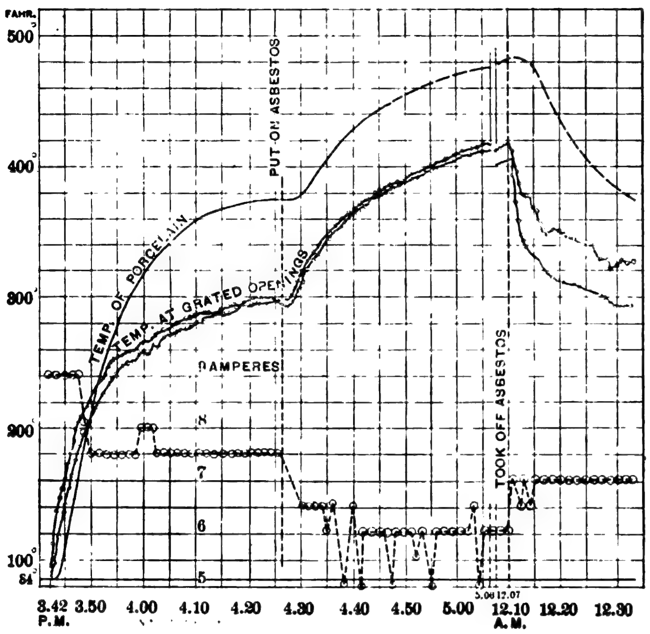


FIG. 1.

obtained from these curves. The time is laid out on the horizontal lines, the vertical lines being lines of temperature. After the heater had been in operation until the temperatures within the porcelain and the temperatures within the heater casing, as indicated by the two lower lines, had become practically constant, we then covered up the discharge opening of the heater with a close-fitting sheet of asbestos, which would prevent the escape of heated air. The effect upon the temperature within the heater casing is at once apparent, and the upward movement of the curve indicates the rate and amount of that rise in temperature. As I have already pointed out, this rise of temperature must mean a lowering in the amount of heat generated.

The throttling action of this can be seen in the fourth curve to which I call your attention. This fourth curve represents the amount of current passing through the heaters and also the amount of heat generated. In the first place, when the current is first closed through the heater you will see that a large flow of current takes place until the heater itself becomes heated up, when the amount of current is automatically throttled down. This of itself is of advantage in more quickly bringing the heater to its maximum temperature. This curve remains nearly horizontal, indicating a nearly steady flow of electricity until it reaches the point where the discharge opening of the heater was closed. You will see at once that the current drops and the amount of this drop indicates the amount of the throttling action of the resisting conductor itself. This also means, and this point I desire to emphasize, that anything which interferes with the discharge of the heat into a car also acts to cut off the amount of heat generated in that heater and hence to prevent in a measure the rise of temperature which would otherwise take place within the heater itself. At the point indicated in these curves, the asbestos damper was removed from the discharge of the heater and the curves then indicate the fall in the temperature of the space above the heater, while the curve showing the amperes rises in a very short time to its normal height, indicating that when the heat is free to discharge from the heater more heat is generated. This action will take place in any heater in a car and will take place in one heater independent of other heaters. This curve, however, may give a wrong impression as to the temperature at the discharge of the opening of the heater itself.

The Fig. 2 has been made from tests in which the temperature at the grated openings has been taken very carefully with thermometers placed against the grated openings but not within the heater case. This would indicate the temperature in front of the heater openings and at points where the clothing of the passengers might possibly touch. I introduce this to simply show that the highest temperature in the air that is reached, is about 180 degs. F. This being the temperature of heated air, it is evident that its effect upon either the clothing or limbs of passengers could not be in any way dangerous or disagreeable. This is due to the free discharge of air up through the heater by which the heat as fast as it is generated is carried into the car. A curve is also shown which is not the curve of temperature of the air discharged from the heater, but is the temperature recorded by thermometers placed within the heater case and within one-half inch above the wire coil. The upper curve indicates the curve of temperature of the porcelain itself and is obtained from the readings of the thermometer placed within the hollow openings of the porcelain. I desire to call your attention to the forms of these curves, both when the temperature rises when heat is first applied, and to the temperature of the curve obtained when heat is shut off. It is seen that the temperature of the porcelain rises rapidly and the temperature also descends rapidly when the circuit is open.

Electricity being a form of energy we may say that electrical apparatus generally transforms into the desired form of energy less than 100 per cent. Now, if the theory of the conservation of force is true, all of the energy can be accounted for in some way. Let us examine for a moment the forms of energy into which electrical energy may be converted. We have, first, mechanical motion; second, chemical action; third, light; fourth, magnetism, and fifth, heat. The list, I believe, comprises all possible forms of force into which electrical energy may be transformed.

As an average condition of the resistance of electrolytes, I find that about 50 per cent. of the electrical energy employed in electrolytic decomposition is transformed into heat in overcoming the resistance of the electrolyte itself and the remaining 50 per cent. is transformed into chemical action. If we take the electric motor, we find that it is impossible to build an electric motor without resistance and when a current passes through this motor we always obtain heat. Therefore, in 100 units of electric energy which is transformed in the motor, 90 per cent. approximately, may be transformed into mechanical action. If now, we consider the incandescent electric lamp and transform 100 units of electric energy, we find about 5 per cent. in the form of light and 95 of heat.

The electric heater is the only case that comes within our knowledge where 100 units of electric energy may be transformed into 100 units of any other one form of force. Careful tests have determined upon 1,047 watts as equivalent to 1 British thermal unit, or 1 pound degree Fahrenheit. Therefore, it becomes an

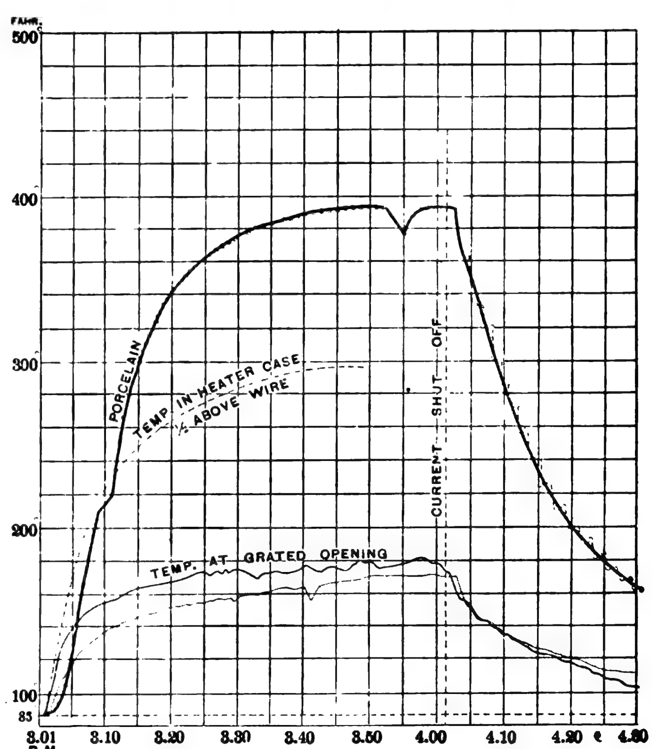


FIG. 2.

easy matter to determine the exact amount of heat which is produced in electric heaters when the consumption of current is known. In this way with a given consumption of current, it is very easy to determine exact values in heat units, or if we know what heat units are required, it is a simple matter to ascertain the exact consumption of electric energy necessary to produce

this amount of heat by means of the electric heater. I think that practical experience in the heating of cars has demonstrated that it requires about 20,000 British thermal units per hour to properly heat an 18-foot car in the latitude of New York State in the coldest weather, and that this amount of heat should be provided as a maximum. The average requirement during the months of the winter when heat is used would not exceed one-half of this amount, or would be approximately 10,000 British thermal units per hour.

The amount of heat required, however, differs somewhat according to the construction of cars, to their exposure to winds on the lines where they are run and to the care exercised by conductors in closing the doors promptly when passengers enter or leave the cars. All of these are points which affect materially the temperature which will be maintained in a car with a fixed amount of heat. Also the number of people in a car affects quite perceptibly the amount of heat required; crowded cars require less heat to maintain a given temperature than is the case with cars carrying but few passengers, due to the amount of heat given off from the bodies of passengers. Experiments have been made as to the effect of passengers upon the temperatures of cars and houses. It has been found that each person gives out 191 British thermal units of heat per hour. When we compare this amount with the average amount of heat required during the cold weather, we find that the heat given out by 52 persons will maintain the same temperature in a car as is required on the average during the winter months. This point has a practical bearing in the heating of cars in that, if a car is heated uniformly as with a stove, it would be found overheated during those hours of the day when the cars are filled with passengers. When electric heaters are used, some roads have established the practice of reducing the heat between certain hours when their cars are filled with passengers. This would still allow a comfortable degree of heat to be maintained in cars and at the same time would allow the use of the extra power for propelling cars at the time when travel is the heaviest.

SIGNALS ON ELECTRIC RAILROADS.[1]

BY J. H. BARNARD.

Railroads can afford telegraph operators at frequent intervals, as where their duties as operators are insufficient to warrant their salaries, they can fill various other duties, whereas this is not true of street railways. Signals, electric or mechanical, are too limited in their range, consequently the telephone is the instrument which can best replace the telegraph line in the hands of our class of employés. Over a two-wire telephone line any conductor or motorman can report in detail a trouble from any of as many stations as you desire to install, and prompt measures be dictated by the highest executive, if necessary.

This fills the want as far as communicating from an outlying point to the office, where there is always some one to notice the call bell; but, unless a separate wire be run from each station to the office, and that at a very considerable expense, there has not been heretofore, as far as I know, a means of setting a permanent signal at a desired point to arrest the attention of the next employé that may pass. This ability, however, even on a double track road, is a very important one. A trolley wire has broken, and you want your lineman from some distant point with the least delay; a car is derailed and unless you have a regular wrecking crew, you want your trackmen with their jacks, linemen with their tackles, or both, and you want them as quickly as possible.

But, however badly this ability is needed on a double track line, it does not compare with its necessity on a single track line. Your cars from one cause or another—you that handle single track lines know how various are the causes and how frequently they can present themselves—get out of schedule, "out of phase," you may call it, and no man living can get them back into phase by the easy methods that are usually apparent, because of your inability to give to distant crews orders complementary to those you would give to those near by. Consequently, the requirements of a single track road are: that from any station, wherever you may be, you must have the ability to call and instruct the men at such points as the particular need demands without calling and so detaining the men at other points.

If this be rendered possible you have gained yet another important power. If a station be located at each turnout, a man at any one of them can set a signal or communicate with another at the next turnout, and herein lies the greatest and only means of reducing to a minimum loss of phase—because in ninety-nine out of a hundred cases, you may say always that general disarrangement begins in localized disarrangements. A car has an unusual number of stops to make, blows a fuse in starting on a grade, is blocked for a few minutes by a wagon across the track unloading, by a thousand and one insignificant things, consequently is late in reaching the next passing point. The car due to pass it there waits, how long? Well, it waits. Probably all its passengers are in high dudgeon, criticise the management and vow (and to a certain extent keep their vows) not to patronize such a line in the future. This is all bad enough, but this is only the beginning of the trouble; each one of these cars is due to meet another car at its next turnout ahead, consequently a few minutes later two cars are awaiting two delayed cars, and again a little later at the second turnout ahead two more cars are waiting, and so it multiplies. If travel at the time be light, your cars may be able to pick up again their lost time, but usually a serious disarrangement occurs from the frequent stops of more than an individual car due to heavy travel. Then when it is of every importance that your cars should move like clock-work to earn every possible nickel, as well as to maintain your reputation, your cars are utterly at a loss. Through ignorance of the opposing car's position, they will lose valuable time at a turnout, when, had they only known it, they might have proceeded to the next; or, after waiting a due length of time they proceed only to meet the other car between turnouts and one had to run back.

It is not that a single track road is, as many assert, not worth building. Many a route will support comfortably the investment required for a single track which would not pay the interest on the bonded debt of a double construction. Indeed, with the means of instructing the car crews when to wait and when not to wait, I assert that under ordinarily good management a single track road may handle smoothly an amount of travel that few will think possible. With such means at your command, or the command of your men, the loss of a schedule by one car can be easily kept to nothing worse. If you have extra turnouts to allow the employment on days of heavy travel of a larger number of cars than ordinarily, you may, in the case of a sudden increase, put out some extra cars to meet it as one would do on a double track road without previous warning to the men beyond the reach of your voice and that without delaying their cars. Should travel not develop as prepared for, you may at pleasure withdraw your cars as they arrive without the remainder waiting at turnouts for cars that would never come.

Nor to do this do you require, except where the road can afford it, anyone in the nature of a train despatcher. If a car is late at a turnout, its crew does one of two things. If it is so much behind its schedule that the rule forbids its proceeding, one of them drops the signal at the next turnout where it is due to meet a car, and when one of the crew of that car answers at the telephone, he is told to come on, thereby limiting any loss of time to only that car which is already out of phase. As for itself, it simply falls back upon the schedule of the car following it, and on this car's right of way precedes it to the last turnout, where, transferring to the car behind any passengers it may still have, it turns back on its own schedule. Such a course entails a slight further delay to the passengers on that car alone, but none to any of the others.

If it is behind its time less than the limit established in the rules, it continues its way, first dropping the signal at the next turnout. Should it fail to reach that turnout on time, the opposing car will have waited for it, because when one of its crew went to the telephone he was not answered, showing that it must have been set to hold his car, presumably by the crew of the car due to meet him there.

This much towards keeping the cars informed of each other's movements is an immense assistance, and to this extent an ordinary signal system, automatic or otherwise, is a great aid, but here a signal system has reached the limit of its possibilities, and still there is another common and most prolific source of general disarrangement, and that is where both of two approaching cars are that late the rules forbid their proceeding; consequently one lies at No. 6 turnout and the other at No. 8, when each might proceed to No. 7, without delaying any car and possibly finding themselves able to make enough time not to delay other cars at 5 and 9, thus ending the trouble at its source. In this case the crew at No. 6 would have set No. 7 signal as would also the crew at No. 8. Any one near the office instrument (an extension to the engine room can be cut in when at any time the office may be vacated so that the engineer may hear calls) noticing the repetition would understand the situation and, calling up both cars, tell them to proceed.

Then, too, after every precaution has been taken to prevent general disarrangement, should one occur—and in spite of all it will occasionally—with the means of talking from whatever station you may be at to such crews as you desire, loss of phase loses much of its sting and trouble much of its victory.

1. Abstract of a paper read before the Street Railway Association of the State of New York, Albany, Sept. 17, 1895.

ELECTRICIANS IN A TROLLEY COLLISION AT OAKLAND, CAL.

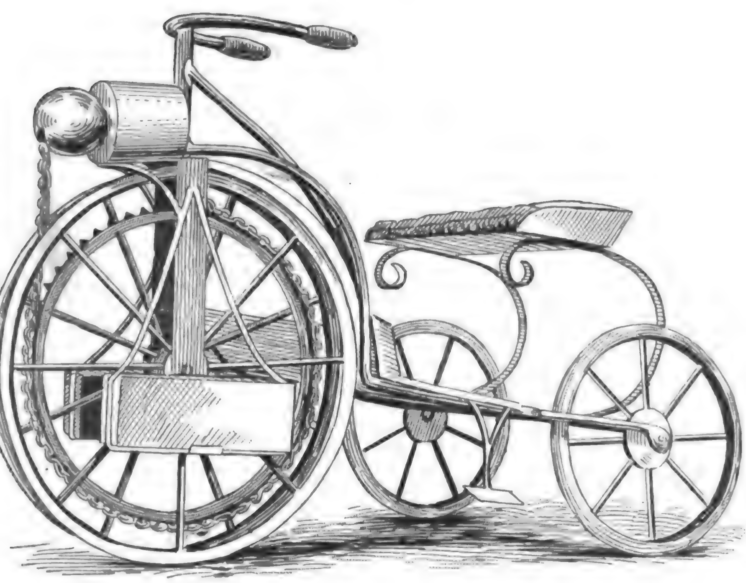
A collision between an electric car and a buggy occurred on Sept. 9, at Oakland, Cal., by which three people nearly lost their lives. The injured people are R. P. Valentine, manager of the Alameda Electric Light and Motor Company; Paul Seiler, proprietor of the Electrical Works of San Francisco, and G. A. Wiese, superintendent of the Fire Alarm and Electric Light Company. R. P. Valentine's life is despaired of. They were driving in a buggy when the horse pulled the vehicle across the trolley tracks. The injuries are all very serious, the three men being thrown violently to the ground.

THE BARROWS ELECTRIC TRICYCLE.

The accompanying engraving represents a novel electric motor vehicle designed by Mr. Charles H. Barrows, of Willimantic, Conn. As will be seen the vehicle is of the tricycle form, but unlike all other motor vehicles of this type the forward wheel is the driving wheel. This wheel is made up with one hub, two sets of spokes, and two rims with solid rubber tires. Between the two sets of spokes is securely fastened a large sprocket rim carrying a sprocket chain, which engages with the very small sprocket pinion of an electric motor carried at the base of the steering spindle of the bifurcated post which straddles the driving wheel, and in which the wheel is journaled in ball bearings. The gearing has a speed reduction of 14 to 1.

The current is obtained from a primary battery contained in two cabinets each 24 x 8 x 8 inches which are disposed one on each side of the driving wheel supported in the centre by a foot piece at the lower end of the bifurcated post, and at the ends by supporting rods reaching down from the shoulder over the wheel. This battery weighs 100 lbs. and has a normal output of 25 amperes at 30 volts for 10 hours and is capable of giving 50 amperes for a short time, thus making available a little over 2 H. P. The long leverage of the gearing between the motor pinion and the driving wheel gives a fast speed electric motor an advantage of three to one in weight over a slow speed petroleum motor for a given speed of the vehicle.

This combination is claimed to be equivalent to at least four horse power required to drive motor vehicles of 1,500 lbs. weight. The entire weight of the Barrows vehicle built to carry two or three



THE BARROWS ELECTRIC TRICYCLE.

passengers is only 300 lbs. Its speed can be varied from a crawl, up to a mile in three minutes, and it is at all times under as perfect control, and in the same manner, as a trolley car.

The carriage part of the vehicle is a light structure consisting of a simple frame work with a wide comfortable seat and two pneumatic tired wheels hung in ball bearings. Each wheel is independently journaled whereby all extra friction on curves is avoided. Steering is accomplished by means of a handle bar similar to the handle bar of a bicycle. Our illustration is made from a photograph of a rough model and does not show the perfect finish and symmetrical form of the machines which will be soon finished.

The front wheel of this vehicle being the driving wheel, and carrying within itself the entire locomotive force, makes practically a mechanical horse, attached to the carriage in its rear, by tube and spindle in the same manner as a bicyle; this horse, as it were, may be detached from one carriage and hitched to another in one minute, and will work as well in a sleigh as in a carriage.

One filling of the cells, it is claimed, will run the vehicle from 100 to 150 miles according to condition of roads and the load carried. Enough of the concentrated solution may be carried for a 500 mile run, at a cost of 50 cents for recharging.

MIDDLETOWN PUBLIC TROLLEY PARTIES.

On the Middletown, Conn., trolley line, which is 4½ miles long, public trolley parties, in which anybody could join on paying 10 cents have been given with success twice a week. These parties have run as high as eight cars, people flocking to enjoy the brisk cool evening air with a tinge of music in it from a band. Mr. E. W. Goss, the superintendent thinks it a good paying move.

MORE WORK FOR THE B. & O. LOCOMOTIVE.

Plans for increasing the operations of its electric locomotive equipment are being considered by the Baltimore and Ohio Railroad Company. They include an extension of the overhead work from the south end of the tunnel line down to Bailey's or even as far as Carroll switch, besides an extension at the north end from Huntingdon avenue up as far as the York road, the top of the hill. There is a very heavy grade on the Belt Line just north of the big bridge over Jones' Falls, and the electric locomotives would be especially useful if they continued their work until the very summit was reached instead of uncoupling when just over the worst of the incline.

MORE CONDUIT ROAD FOR WASHINGTON, D. C.

The work of placing the underground conduit electric system now in operation on 9th street, Washington, over the entire road owned by the Metropolitan Street Railroad Company will be commenced Oct. 10. Mr. S. L. Phillips, the president of the company, states that everything is in readiness for the beginning of the work, and that nothing will be allowed to prevent its being rapidly pushed. "Contracts have been made," says Mr. Phillips, "with the Pennsylvania Steel Company for all the wheel rails, slot rails and conductor rails; with Mr. Edward Saxton to build the conduit and do all the steel work; with Davis & Thomas for casting yokes, manhole covers and other castings generally; with J. H. McGill for the foreign and domestic cement; with Washburn & Moen for the copper bars which are used in conducting the electric current; with H. L. Cranford & Co. for the entire asphalt work, and with the Diamond State Iron Company of Wilmington, Del., for the bolts, tie rods, etc. The road will be running by August 1 next. It will comprise thirteen and one-half miles of road, or a mile and a half more than the present east and west lines. This increase will be due to the road being extended at the east to 15th street northeast and to Georgetown College at the west end. The unprecedented success of the Connett system on the 9th street road has induced the Metropolitan railroad to duplicate in every detail that construction over its entire lines."

CAR BUILDING COMPANIES IN ST. LOUIS TO COMBINE.

A report is current to the effect that the St. Louis Car Company and the American Car Company are about to consolidate. It was said that the new concern will establish in St. Louis a large plant for the manufacture of all kinds of cars and appliances. The capital stock of the new company is not yet determined upon, but it will be at least $1,000,000.

DETROIT'S POSTMASTER WANTS THE POLES KEPT UP.

RECENT actions of the board of works in compelling the Detroit Electric Light and Power Co. to take down about eighty-five of its poles, to all of which were attached letter boxes, have resulted in a hugh kick to Postmaster Enright from the thousands who found it a matter of great convenience to use them.

NO FENDERS FOR THE DE KALB AVE. ROAD.

This week the De Kalb Avenue Road, Brooklyn, will defend 40 suits brought against it by the city because of Col. John Partridge's refusal to equip his cars with fenders. His counsel contend that the aldermen have no right to order the use of fenders and none to regulate the speed of the cars.

THE SOUTH CHICAGO CITY RAILWAY CO. are increasing their plant; last week they purchased a 500 K. W. Westinghouse slow speed generator, and a 1,000 H. P. cross compound Green-Wheelock engine, made by the Cramps. The South Chicago City Railway Co. have also reserved the right to order another engine and generator, same as those mentioned, before next Spring. Sargent & Lundy are the consulting engineers for the company.

LETTERS TO THE EDITOR.

STANDARDIZING LAMP SOCKETS.

We have read with interest your editorial this week on "Standardizing Lamp Sockets," and trust it will be the opening wedge in reforming the unnecessary multiplicity in lamp sockets in use in the market to-day. We realize that it is a difficult problem, as every manufacturer of apparatus seems desirous of having a distinct socket to advertise his system. We think, however, when the mutual advantages to the manufacturer and consumer is better understood that the abuse will right itself.

BEACON LAMP COMPANY,
Per E. E. Cary.

BOSTON, Sept. 27, 1895.

TELEPHONY.

THE HARRISON CO. HARD AT WORK.

So far from withdrawing from work in Indiana, Mr. E. H. Andress, the secretary and general manager of the Indiana Harrison Telephone Construction Co. at Lafayette, Ind., writes: "We are putting in new plants constantly, and now have contracts for seven new exchanges. At Crawfordsville, where the first contract was for 75 telephones and the exchange started with that number, they now have 175 and are still adding new subscribers. At Rensselaer they started with 75 and now have 139. At Columbus they started with 100 and now have 160. Here at Lafayette, on January 1, 1895, the exchange opened with 300 subscribers and now we have 560, and are adding at the rate of 80 per month. This speaks for itself and needs no comment."

MR. KEELYN'S ANTI-MONOPOLISTIC ATTITUDE.

Mr. J. E. Keelyn, of the Western Telephone Construction Co. has issued the following circular letter:—

"Referring to an accusation through a Boston paper to the effect that the movement to prevent the illegal combination between the Bell Company and Western Union, Western Electric, American Telephone & Telegraph Co. and the licensees of the Bell Company has for its effect the disturbance of the stock of the Bell Company, the writer desires to say that this is an absolute falsehood, without any possible basis. The writer does not care what the price of Bell stock is.

"The Bell Company and the parties to this most monstrous compact, have through specific arrangement in writing agreed to and invoked the laws and flaunted its patent papers in nearly every court in the land, to sustain a monopoly.

"The writer's motive was inspired principally by a belief that this contract, in writing, specifically violated, not only the Federal laws but the statutes of nearly every state; that in conformity with this contract, in spirit and will, a monopoly was being maintained unlawfully. That this unlawful monopoly was oppressive in more than one way to the writer and those with whom he had interests. That the rate-cutting in vogue where competition was started was in pursuance of clause 5, taken together with clause 2 of Article 2 of the agreement, to stifle competition, and his position in the telephone business required his individual action.

"Data is being prepared to properly present in the form of a petition; and as the Bell Company seems to love law so well, possibly it may have misinterpreted its meaning as affecting them."

TELEPHONIC THIEF CATCHING.

A special dispatch from Georgetown, Tex., of Sept. 15, says:—Yesterday afternoon while Sheriff Purl was in the telephone office awaiting his turn, he heard the operator repeating a message from Florence to Salado sent via Georgetown from the sheriff of Llano county to the officers of Bell county asking them to look out for and arrest Tom Ratliff, describing the man he was pursuing. The description included that of a horse, a red saddle blanket and a blanket of like color tied on behind, and it was this latter article that brought the man to grief. Just at this time Mr. Purl turned his head and looking out the window saw a man fitting the description riding by. He immediately gave chase and put him under arrest. When landed in jail, Jay Owens, who is under sentence to hang, recognized the prisoner as Lige Ratliff, with whom he had served a term in the penitentiary.

FIGHTING TELEPHONIC MICROBES IN CHICAGO.

Health Commissioner Kerr, of Chicago, has struck with vigor at what he deems an abuse and a menace in the system of the Chicago Telephone Company. Lately the telephone company placed over both public and private telephones in the city a notice reading: "Place the lips directly within the mouthpiece of the receiver." This instruction is regarded by the commissioner as involving a vital danger to the public health, and as such, to be rescinded speedily. He has sent a letter to the general offices of the telephone company. The letter was as follows:

Chicago Telephone Company.

Gentlemen:—Upon my return to the city I found my telephone labeled as follows: "Place the lips directly within the mouthpiece of the transmitter," and I am informed that similar labels are placed on all the telephones of your company. I have to request that you will immediately cause the removal of this filthy and disease-breeding instruction.

Respectfully yours,
WILLIAM R. KERR,
Commissioner of Health.

No answer was received by Commissioner Kerr, and the latter decided to warn the public of the danger in following the instructions of the company. Dr. Reilly, the assistant health commissioner, was especially serious in his denunciation of the practice of placing such instructions upon telephone instruments. He said that diphtheria, consumption, pneumonia, eczema, influenza and other germ-breeding diseases might be thus communicated. Dr. Reilly, in discussing the matter, said: "To place the lips directly within the mouthpiece of the transmitter is to invite disease. No one using the telephone may know that the person just preceding him or her was not suffering from some horrible germ disease."

THE MEMPHIS FIRE SERVICE.

CHIEF BURKE, of the Memphis, Tenn., fire alarm department, has put in metallic circuit telephones in all the stations and engine houses. There is also a direct line between the telephone exchange and the central fire station, for fires only. This is also supplemented by District Messenger service wires.

BLOOMERS FORBIDDEN IN THE CHICAGO TELEPHONE EXCHANGE.

An order has been issued in the Chicago telephone exchanges, forbidding the women operators to wear bloomers while on duty. The Company thinks that skirts are better and nicer.

UNPRECEDENTED BELL TELEPHONE OUTPUT.

The record breaking net increase in the Bell Telephone output, 12,659 instruments for the month ending Sept. 20, as compared with 2,568 for the corresponding period a year ago, furnishes one of the best indications of general trade improvement. The Bell Telephone output is of a general rather than of a specific character. The evidence of expansion is not confined to any local territory, but covers the entire country, and is therefore an important consideration when viewing in a broad way business returns. The total number of instruments outstanding is 649,219 as compared with 575,223 last year.

TELEPHONE NOTES.

DOUGLAS, GA.—E. A. Buck will construct a telephone line.

JACKSON, GA.—Stephen B. Kinard will construct a telephone line to McDonough.

PRINCETON, N. J.—The work of putting telephone wires underground has been completed.

JASPER, TEX.—There is talk of establishing a telephone between here and Kirbyville.

SHELBY, O.—The Central Telephone Company has begun operations and the lines of poles are being rapidly put up.

INDIANAPOLIS, IND.—The Phœnix Telephone Company is to secure a 20-year franchise.

MARQUETTE, MICH.—A telephone war is brewing here through the efforts of two rivals of the Bell Company to enter the local field.

PINE BLUFF, ARK.—T. A. Parrish, representing the Harrison International Telephone Co., of Chicago, proposes organizing a $14,000 stock company.

MOUNT CARMEL, ILL., is now included in the network of lines controlled by the Cumberland Telephone Company, the linemen having reached this city from Evansville.

WEST SUPERIOR, MINN.—The Northwestern Standard Telephone Company has been granted a thirty-year franchise by the common council on the understanding that they compete with the present concern and give cheaper rates.

HANNIBAL, MO.—F. C. Wood, manager of the Automatic Telephone Company, has closed the sale of interests in the Hannibal plant to J. H. Richardson, of Quincy, and C. G. English, of Kirksville.

GALESVILLE, WIS.—The city council has granted the Luce-Veitch Telephone Company a franchise for the exclusive right of building and maintaining line, in the city for a period of twenty years.

PORT JERVIS, N. Y.—The Sullivan County Telephone Company are extending their wires to every important point in the county and intend to run a line through the Delaware Valley from Deposit to Port Jervis.

THE WESTERN TELEPHONE CONSTRUCTION CO. shipped about 200 telephones to Lynchburg, Va., to take the place of another make there, which had not given satisfaction. The Western Telephone Construction Co. have shipped a 100 capacity telephone exchange switchboard to Negaunee, Mich.

SALINA, KAS.—The Salina Telephone Co. have completed their line to Assyria and connections have been made.

KIRKWOOD, MO.—A special franchise has been granted the Bell Telephone Company to erect poles for its new suburban line.

MANCHESTER, N. H.—The Manchester Telephone Company, with a capital of $125,000, has filed incorporation papers.

ELIZABETH, N. J.—The Elizabeth Telephone Company has again resumed the work of constructing its line through this city.

NEW BERNE, N. C.—The work of putting up the telephone system of this city has been actively entered upon.

DECORAH, IA.—The Iowa Telephone Co. will put in an exchange at Decorah.

DELAWARE, O.—The city council has granted an extension of the telephone franchise to D. S. Fisher and associates for six months.

MONTPELIER, VT.—The Bell Telephone Company's contracts and leases on its patents, heretofore controlled by A. C. Brown, have been transferred to the Vermont Telephone Company.

ALBANY, N. Y.—The Home Standard Telephone Company will run a telephone line from Albany via Schoharie, Cobleskill and Oneonta to Binghamton this fall.

FREDERICK, MD.—The Interstate Telephone and Telegraph Company of Frederick has 125 subscribers. Operations will begin at once.

SAGINAW, MICH.—The Saginaw Valley Mutual Telephone Company proposes to establish a sort of co-operative exchange in this and other cities within a radius of 50 miles or more.

SHEBOYGAN, MICH.—The Bell Telephone company announces a rate of $16 a year after October 1. The new exchange, in course of erection, charges $24, and has 100 subscribers.

MENOMINIE, WIS.—Articles of incorporation have been filed by the Menominie Telephone Company; capital, $12,000; incorporators, Jas. D. Hills, Sanford J. Heafield and Elmer J. Newson.

MELROSE, MASS.—The Century Telephone Co. began the construction of the Melrose exchange early in September. There are already more than 100 subscribers.

INDIANAPOLIS, IND.—Lightning started a fire in the Telephone Exchange building, on Illinois and Ohio streets, and the whole system was burned out, resulting in extensive loss.

BEEVILLE, TEX.—There have been parties in town soliciting stock for a telephone line to be constructed from Beeville to Tilden via Oakville.

MIDDLETOWN, N. Y.—Mr. Adolph R. Pflaum, the manager of the Orange County Telephone Company, has tendered his resignation.

BROOKHAVEN, MISS.—Electrician J. E. Evans has completed a telephone line from this place to Moreton and Helms' saw mill, near Bogue Chitto. The line is ten miles long and was built by the Moreton & Helms Company for private use.

LANSING, MICH.—The Michigan Bell Telephone Company is sending circulars to all its subscribers offering to make rates of $4 and $5 per quarter for residences and business houses, respectively, for one year from October 1.

CRAWFORDSVILLE, IND.—Evan S. Shelby, of Linden, has completed his telephone lines from this city to Linden. From Linden he has lines connecting with New Richmond, Kirkpatrick and Romney.

VOSBURG, MISS.—Capt. C. W. Gallagher, of Meridian, representing the Standard telephone, has closed a contract with some of the leading citizens of Vosburg and Paulding to build a telephone line from this place to Paulding.

ARGYLE, N. Y.—The North Argyle Union Telephone Company has been formed, to connect Argyle and North Argyle, Washington County; capital $250; and directors: Wm. D. Stevenson, Alex. S. Cuthbert, Rodney Vanwormer, Robert B. Scott and others of Arygle.

CATLETTSBURG, KY.—The Catlettsburg Telephone Company have placed poles for their service extension as far down as Keys Creek, and will connect a number of the residences and business places of Normal with the regular Catlettsburg service at an early date.

MARKLEYSBURG, PA.—There has been chartered the Somerfield Telephone Company, to construct and operate a line connecting Petersburg, Markleysburg, Confluence, Uniontown, and other towns in Somerset and Fayette counties. M. R. Thomas, of Markleysburg, is President.

GRAND RAPIDS, MICH.—Articles of incorporation of the Citizens' Telephone Company have been filed. The articles provide that the office of the corporation shall be in this city and that the term of its existence shall be thirty years. The capital stock is $10,000, of 1,000 shares at the par value of $100 each.

NORWALK, O.—The Sandusky Telephone company is just now rushing to completion the building of its line through the city. The work is being done by the Ohio Harrison Telephone Construction Company and is under the personal supervision of W. W. Graham and W. R. Barkdull.

FRANKLIN, IND.—The vote granting the 20-year franchise to the Phœnix Telephone Company has been reconsidered by the city council, and the whole matter was then laid on the table. This was done in deference to public sentiment, which is unalterably opposed to long term franchises.

PHILADELPHIA, PA.—The projectors of the new telephone scheme are pushing their plan determinedly, and they claim to have secured such control of the Mutual Automatic Telephone Company's stock that they can take immediate advantage of its franchise.

BEAUMONT, TEX.—The Beaumont Telephone Company has been formed. Purpose, the construction of telephone lines and establishment of exchanges in Jefferson, Hardin, Tyler, Jasper, Orange, Liberty, Harris and Galveston counties. Capital stock, $10,000. Incorporators, E. L. Bacon, J. F. Keith, Minnie King.

MOBILE, ALA.—The pole and wire work of the new telephone company is rapidly approaching completion. Since May 1, 1,200 poles have been erected and since June 20, one and one-half miles of cable and three hundred miles of wire have been strung. Mr. R. F. Martindale is in charge of the work.

LA GRANDE, ORE.—Articles of incorporation have been filed by local people for a telephone company to build and operate a telephone line from La Grande to Union and to Elgin. The incorporators are J. W. Scriber, F. D. McCully and W. W. Hindman. The capital stock of the company is $3,000.

BRIGHTON, MASS.—Under an existing law, passed about a year ago, all the wires must be put under ground. The N. E. Tel. and Tel. Co. has nearly completed its work in the congested portion of the city and has commenced its work on the main lines in the outlying districts.

NORFOLK, VA.—J. A. Helvin, of Haverstraw, and ex-Warden and ex-Postmaster W. R. Brown, of Newburgh, have been granted franchises for constructing a telephone line in the city of Norfolk, Virginia, and are negotiating for a franchise in the city of Richmond.

ALBANY, GA.—A petition has been received from S. B. Brown, J. A. Johnson, J. W. Mock, D. H. Pope & Son, et al., asking for permission to place poles along the side of the public road between Albany and Acree in the construction of a telephone line between Albany and Tifton. The request of the petitioners was granted.

PAULDING, LA.—At a meeting of the stockholders of the Vosburg and Paulding telephone line, the following officers were elected: M. H. Turner, of Vosburg, president; B. W. Skarborough, of Paulding, vice-president; Dr. F. McCormick, of Vosburg, secretary and treasurer; Gus. S. Harmon, of Paulding, assistant secretary and treasurer.

MERIDIAN, MISS.—The Meridian & Tuscahoma Telephone Company, covering the postoffices of Zero, Causeyville and Hurricane Creek, Miss., and Pushmataha, Butler, Mt. Sterling and Tuscahoma, Ala., has been put into operation. Another line is being constructed to Daleville, Miss., via Marion, Topton and Lockhart stations.

PENN YAN, N. Y.—The village trustees have decided to grant a franchise for a telephone system to W. Stanley Bruen. There will be no central, but an automatic board. The rates will be $24 a year for business places, and $18 for residences, &c. The lines are to be extended to Keuka and Gibson's. The office will be with the electric light company.

GRAND RAPIDS, MICH.—The American Telephone and Telegraph Company has informed the council that it intends to construct a line between Grand Rapids and Chicago giving the city the benefit of a long distance telephone connection with that city; and it has asked for permission to erect poles and string wires.

ALICE, TEX.—The Alice, Wade City and Corpus Christi Telephone Company has filed its charter in the department of state. Purpose, the construction and maintenance of a telephone line in and through the counties of Cameron, Hidalgo, Nueces, Duval, Live Oak, San Patricio, Webb, Starr, Zapata, Bee, Karnes, Wilson and Bexar. Capital stock, $3,000. Incorporators: George Hobbs, Thos. C. Wright and John Wade. Place of business, Alice, Nueces county.

FARGO, N. DAK.—The citizens of Fargo are offering inducements to the American Telegraph company to string their wires into this city. A franchise has been granted by the city council, and it is understood that only about sixteen miles are needed to close the gap. Grand Forks will be asked to join. It is probable that the line will eventually be extended to Winnipeg, where a good paying business is assured as soon as the new line is constructed.

PERSONAL.

DOWNES & HENSHAW.

THIS is the title of a new firm of consulting electrical and mechanical engineers just formed in Rhode Island, with headquarters in the Studley Building, Providence. Its members are F. V. Henshaw and L. W. Downes.

Mr. F. V. Henshaw was born in Brooklyn, N. Y., but his early life was spent chiefly in Montreal, Canada. His father was the late George H. Henshaw, a well-known civil engineer of Montreal. After leaving school Mr. Henshaw took up the study of chemistry at Bishop's College, Montreal, under Prof. J. T. Donald, but decided, after a few years' work, to abandon it in favor of engineering, and spent some time on a survey of a part of the St. Lawrence River during the summer and fall of 1886. The subject of electricity had attracted his interest at an early age, and being offered an opening in the Royal Electric Co. of Montreal, he entered their employ in the spring of 1887, where he became assistant to Mr. Frederick Thomson, a brother of Prof. Elihu Thomson. The Royal Electric Co., besides manufacturing the Thomson-Houston apparatus, did a great deal of original work, and while in their employ Mr. Henshaw was engaged in the design and construction of probably the first alternate current dynamo built in Canada. In the spring of 1889 Mr. Henshaw left the R. E. Co. to take a position with the C. & C. Electric Motor Co. of New York, where he remained until August, 1895. During that period this company rose from a small concern making motors not larger than 1 H. P. up to one of the largest manufacturers of stationary motors and dynamos in the country. Mr. Henshaw's work consisted chiefly in designing, estimating and testing machines and apparatus, and most of the standard output of this company is largely his work. It may be mentioned that Mr. Henshaw was one of the first to design direct connected motors for very large ventilating fans and blowers.

Mr. L. W. Downes is a native of Providence, R. I. and the son of Mr. L. T. Downes, president of the What Cheer Fire Insurance Co. of that city, who was engaged in the woolen milling industry in its early days and was active in introducing new machinery and inventions from abroad, importing among other things a set of the first Wheatstone telegraph instruments used in this country. Mr. Downes graduated from Trinity College, Hartford, in 1888, and went abroad, entering the City & Guilds of London Central Institute where he remained a year studying electricity under Prof. Ayrton. Returning to this country he entered the Narragansett Electric Light Co., of Providence, which operates one of the largest alternating, arc and power stations in the country. In 1891 Mr. Downes went to New York to take a position with the C. & C. Electric Co. where he was engaged in a great deal of experimental work in relation to dynamo manufacture, making among other things some accurate determinations of the magnetic values of irons and steels which are still in constant use. In the fall of 1892 Mr. Downes left the C. & C. Co. to take up consulting engineering work in Providence. For the past three years he has devoted himself to experimental work particularly in regard to improvements in insulation for electric light wire; and has also conducted a number of important tests for the Narragansett Electric Light Co. and The Union Ry. Co. of Providence. Mr. Downes' improvements in asbestos insulated wire were noted in THE ELECTRICAL ENGINEER, of Apl. 17, 1895.

DR. A. P. NORTON, of New York has been elected president of the National Society of Electro-Therapeutists, and the next annual meeting will be held in this city.

MR. HENRY P. MERRIAM, formerly in charge of the electrical and mechanical work of the Albany Railway, is now in the service of the Standard Air Brake Co., and is a valuable acquisition. His practical contributions to the *Street Railway Journal* show intimate acquaintance with street railway work and problems.

MR. S. A. DUNCAN, formerly president of the National Electric Light Association and recently elected president of the Old Time Telegraphers, is now engaged in the business of contracting for electric light plants and electric railways, and has his offices in the Bakewell Building at Pittsburgh.

MR. C. F. HOPEWELL, a graduate of the Mass. Inst. of Technology and recently superintendent of the central station at Pittsfield, Mass., has been appointed superintendent of lamps and inspector of wires for the city of Cambridge, Mass., in the place of Prof. C. H. Morse, resigned.

MR. C. D. MOSHER, of 1 Broadway, the inventor of the Mosher water tube boiler, adopted for the U. S. torpedo boats, is equipping with them a 100 foot, twin screw, 2,000 H. P. steam yacht, to make a speed of 35 miles an hour, and with coal capacity enough to carry her across the Atlantic.

MARRIED.

STOCKBRIDGE—VON RODENSTEIN.

The marriage is announced of Mr. George Herbert Stockbridge, formerly of the U. S. Patent Office and now practicing as a patent attorney in New York, to Miss Louise Adele von Rodenstein, of Washington.

BOSS—RITTLE.

Mr. John C. Boss, of Elkhart, Ind., was married last week to Miss Anna Rittle of that city. Two or three years ago on arriving in Elkhart, a young man of country training, he joined the Lakon Electrical Co., of which to-day he is the sole proprietor.

LEONARD-GOOD.

MR. H. WARD LEONARD, the electrical engineer and inventor, was married on August 24, at Geneva, Switzerland, to Carolyn, daughter of Mrs. Anna M. Good.

O'BRIEN-SNYDER.

MR. N. W. O'BRIEN, supt. of the Wilkesbarre, Pa., Electric Light Co., was married on Sept. 16 at Phillipsburg, N. J., to Mrs. Lillie Snyder, of that place.

EDUCATIONAL.

ELECTRICAL CLASS AT PEOPLE'S PALACE, JERSEY CITY.

This course is to open early in October. Tuition is to be very low in cost and within the reach of all. The course will be conducted on an elementary plan, and Profs. Houston and Kennelly's elementary grade pamphlets will be used as text books. Practical instruction in electro-plating will complete the present course. The directors of the People's Palace are lending much encouragement and valuable assistance to the undertaking. The instructor will deliver popular lectures at intervals for the benefit of those interested and who may not have found it convenient to join the class at the start. Mr. Joseph Mason Naylor is instructor.

REPORTS OF COMPANIES.

WESTINGHOUSE ELECTRIC.

The Westinghouse Electric & Mfg. Co. has declared its regular quarterly preferred stock dividend of 1¾%, payable Oct. 1.

PERKINS LAMP CO.

REPORTS have been floating around New England to the effect that the old Perkins Lamp Co. would soon resume business. It cannot be found that there is any truth in these rumors, which probably were started by the fact that an offer has been made to the Boston stockholders for their holdings in the company, with a view to liquidate the assets of the company and wind up the affairs.

NEWS AND NOTES.

"NIAGARA ON TAP."

An illustrated lecture on the above subject was given before the New York Electrical Society at Columbia College on Sept. 27 by Mr. T. C. Martin, who described in a popular manner with the aid of numerous lantern slides the various details of the work done in the recent electrical utilization of Niagara. The subjects of long-distance transmission, use of power on the Erie Canal for freight and passengers, the use of power locally at the Falls, the use of electrical craft on the Niagara River and Lake Erie, and other points of interest, were touched on. President Lieb was in the chair. Secretary Guy is providing a good programme this year for the Society.

A CIVIL SERVICE ELECTRICAL EXAMINATION.

Mr. Lee Phillips, secretary of the New York City Civil Service Commission informs us that they will shortly hold an examination for the position of Chief Inspector of Electrical Appliances in the Fire Alarm Telegraph Department, and that they will be glad to furnish application blanks, which may be secured at the office in the New Criminal Court Building.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED SEPT. 24, 1895.

Accumulators:—

Method of Making Porous Plates or Electrodes, J. Johnson and J. H. Robertson, Brooklyn, N. Y., 546,789. Filed Apl. 2, 1895.

The herein described method of making an electrode for a battery which consists in making a mechanical mixture of molten metallic lead and granulated pumice stone, and subjecting the mixture to an electric current.

Alarms and Signals:—

Electrical Indicating System for Annunciators, W. F. Banks, Milford, Conn., 546,874. Filed Oct. 2, 1893.

An indicator adapted to operate with the call box to indicate the special call sent and a controlling switch by which connection may be established between the call box and the indicator.

Distribution:—

Production of Displaced Phases and Rotary Fields, C. S. Bradley, Avon, N. Y., 546,756. Filed Dec. 24, 1894.

For description see paper by same inventor, page 322 this issue.

Frequency Changer, E. J. Berg, Schenectady, N. Y., 546,806. Filed June 21, 1895.

An induction motor having its inducing member supplied from the lines and its induced member supplying other lines, drills or other apparatus requiring currents of low frequency connected to the lines supplied from the induced member of the induction motor, a generator of alternating currents operated by the induction motor, and an exciter supplying the generator and the continuous current coils upon the drills.

Dynamos and Motors:—

Electric System, M. J. Wightman, Johnstown, Pa., 546,724. Filed Apl. 8, 1895.

Consists of a single armature and a plurality of fields, independent connection from the source of current supply to the fields a connection from the source of current supply to the portion of armature controlled by one field, said connection being separate from the connection to the field and a connection between the portion of the armature controlled by another field and the translating device.

Attachment for Electric Generators, G. W. Pickett, Denver, Col., 546,901. Filed Jan. 12, 1895.

Gear mechanism which rotates the commutator which gives a pulsating current in such a manner that it will move slowly while the voltage between the two revolving brushes is at the maximum and rapidly when it is at the minimum.

Electrical System of Motor Regulation, M. J. Wightman, Johnstown, Pa., 546,966. Filed March 27, 1895.

A counter electromotive force regulator consisting of a dynamo, having a single simple armature, one portion of which armature is in shunt to the source of constant potential and another portion of which is in shunt to the source of constant potential and in series with the translating device.

Electrometallurgy:—

Amalgamator, G. M. Urie, San Francisco, Cal., 546,749. Filed April 5, 1895.

Details of a device for saving the float gold.

Process for Treating Zinc Bearing Ores, E. A. Ashcroft, Broken Hill, New South Wales, 546,873. Filed Aug. 17, 1894.

Consists in first leaching the oxidized ore with a solution containing a ferric salt, to precipitate the iron from said solution and dissolve the zinc, secondly electrolyzing the resulting zinc bearing solution by first passing it around metallic cathodes to precipitate the zinc, and then around iron anodes to impart a ferrous salt to the solution, and subsequently raising the ferrous salt to the ferric state and thereby regenerating the original ferric salt solution.

Lamps and Appurtenances:—

Means for Varying Light for Incandescent Electric Lamps, C. A. Hussey, New York, 546,668. Filed Sept. 29, 1893.

Carbon rods are placed in series with the filament and cut in or out by a switch.

Electric Arc Lamp, C. Weber, F. Goellner and A. Schweitzer, Alleghany, Pa., 546,689. Filed Nov. 19, 1894.

Relates to mechanism of a lamp employing circular carbons.

Electric Arc Lamp, R. Schefbauer, Paterson, N. J. 546,826. Filed Nov. 16, 1894.

The carbons are secured upon swinging arms provided with segmental racks engaging pinions upon one shaft, by the movements of which pinions the carbons are brought together or separated.

Electric Arc Lamp, R. Schefbauer, Paterson, N. J., 546,827. Filed Mch 5, 1895.

Details relating to patent above.

Electric Arc Lamp, R. Schefbauer, Paterson, N. J., 546,828. Filed Mch. 5, 1895.

A helix in the main line circuit to the carbons and a high resistance helix in shunt, and a contact preserving switch between the binding posts, so that the attendant can effectually turn off the current from the lamp without disturbing any other lamps on the circuit.

Measurement:—

Screening Electrical or Other Instruments and Apparatus, W. E. Ayrton & T. Mather, London, Eng., 546,802. Filed July 3, 1893.

In combination with a transparent cover for electrical and other instruments and apparatus a transparent electrically conducting screen formed of adhesive material.

Electric Meter, J. A. Dejardin, Paris, France, 546,917. Filed Apl. 20, 1895.

A wattmeter embodying a pivoted balance beam.

Miscellaneous:—

Time Stamp, J. J. Busenbenz, Chicago, Ill., 546,651. Filed Sept. 29, 1894.

The train gear is actuated by an electric motor.

Apparatus for Exterminating Vegetation, A. Scheible, Chicago, Ill., 546,-652. Filed Jan. 24, 1895.

The current flowing from one electrode to the other is caused to pass through the stalks and roots of two sets of plants in series.

Electric Light Display System, J. E. Woodbridge, Duluth, Minn., 546,799. Filed July 8, 1895.

An advertising sign in which various combinations of lamps can be effected.

Electromagnet for Pipe-Organs, E. S. Votey, Detroit, Mich., 546,834. Filed Jan. 21, 1895.

Apparatus for Purifying Water, T. Craney, Bay City, Mich., 546,814. Filed Dec. 8, 1894.

A combination of an electrolytic tank and evaporator.

Music Leaf Turner, W. E. Somers, Sag Harbor, N. Y., 546,908. Filed Nov. 24, 1894.

Railways and Appliances:—

Continuous Current Rectilinear Motor, C. E. Woods, Chicago, Ill., 546,691. Filed Apl. 6, 1895.

Object is to provide means whereby a continuous current may be supplied to an electromagnetic element carried upon a vehicle to produce shifting magnetic poles adapted to react upon fixed poles situated along the way.

Insulating Support for Electric Wires, J. N. Bulkley, Ridgeway, Pa., 546,837. Filed Mch. 4, 1895.

Consists of an insulating bar adapted to support a bracket for trolley wires.

Switches, Cut-Outs, etc.:—

Electric Time Switch, J. F. McLaughlin, Philadelphia, Pa., 546,674. Filed Apl. 11, 1893.

An automatic electric time switch consisting of a rotary switch for closing and opening an electric circuit, a spring motor for rotating the switch, a lock for the switch motor, a time piece setting mechanism controlled by the time piece and connections between the setting mechanism and switch motor lock whereby the time piece will operate to release the switch motor at predetermined changeable times.

Electric Switch, G. E. Linton, Worcester, Mass., 546,820. Filed Jan. 4, 1895.

Provides means for clamping the contact-pieces into close engagement with the switch knife.

Electric Switch, G. E. Linton, Worcester, Mass., 546,821. Filed Jan. 4, 1895.

Details relating to a knife snap switch.

Fuse-Connector, A. Gartner, Newark, N. J., 546,957. Filed July 25, 1895.

A terminal consisting of a plate provided with a central raised portion forming a spring loop, said loop projecting from one side of said plate and perpendicular thereto, and of an extension integral with and lapped under said plate.

Telegraphs:—

Telegraphic Vibrator, P. LaCour, Askovshus, Denmark, 546,892. Filed May 7, 1895.

The combination, with a vibrator, of a loose circuit-controlling body movable relatively to the vibrator and arranged to be actuated by the movement thereof, and a catch for automatically holding back the said circuit-controlling body after it has been actuated by the movement of the vibrator.

Telephones:—

Self Acting Commutator for Telephones, S. Berditschewsky Dit Apostoloff & M. Freudenberg, Paris, France, 546,725. Filed Mch. 27, 1895.

Details of an automatic telephone exchange

Telephone System, W. W. Dean, St. Louis, Mo., 546,731. Filed May 18, 1895.

Object is to provide improved switching apparatus at the central station and an improved form of local transmitter-circuit at the sub stations.

Combined District Telegraph and Telephone System, E. E. Salisbury and A. E. Dean, Tacoma, Wash., 546,904 Filed Aug. 21, 1894.

For verifying the signals of the call-box and for giving orders for messengers, thereby saving the time generally consumed by the messenger in going to the house of the subscriber.

Telephone, G. A. Tower, M. Hunter and J. P. Eastwood, Richmond, Va., 546,-965. Filed Dec. 20, 1894.

A special arrangement of microphone contact.

Telephone Attachment, L. J. Gerson, Philadelphia, Pa., 546,972. Filed Jan. 14, 1895.

A telescopic mouthpiece provided with a universal joint.

LEGAL NOTES.

LIGHTING CONTRACTS FOR A TERM OF YEARS ILLEGAL IN PENNSYLVANIA.

At Chester, Pa., Judge Waddell has handed down his opinion in the injunction proceedings against the city of Chester, restraining its officers from making a contract with the Beacon Electric Company to furnish light to the city for a term of five years. He decides against the city, taking the ground that one Council cannot appropriate the money of a succeeding Council. While there is no express provison in the act prohibiting a city of the third class from making a contract for a term of years, he believes that such a contract would be an excess of authority, and for this reason decides against the city. The Beacon Electric Company will appeal the case to the Supreme Court. By awarding a contract for five years the city would save $16,300, and the action of Council was approved by the great mass of taxpayers.

SUIT FOR DAMAGE OF OMAHA WATER MAINS BY ELECTROLYSIS.

Receivers Bierbower and Hunt, acting for the Farmers' Loan & Trust Company of New York, bondholders of the Omaha Water Company, have filed a damage suit in the United States Court against the Omaha Street Railway Company for $250,000 for alleged damage done the mains of the plaintiff by vagrant electricity from the motor wires of the defendant throughout the city. The plaintiffs allege that the damages already sustained from such cause have cost the water company a large sum, necessitating the replacing of large reaches of mains. The court is asked to assess such damage upon the street railway and compel it to remove the menace to plaintiff's mains.

UNITED STATES vs. AMERICAN BELL TELEPHONE CO.

The case of the U. S. *vs.* the American Bell Telephone Co., involving the validity of the Berliner patent issued in 1892, after lingering nearly its full ordinary term in the Patent Office, then held invalid by Judge Carpenter, who in turn was overruled by the Circuit Court of Appeals—has now been docketed in the U. S. Supreme Court at Washington.

Mr. E. G. Bernard, E. E., of the E. G. Bernard Co. of Troy, N. Y., writes: "We desire to compliment you on your Data Sheets, as we think it will be thoroughly appreciated by those interested in the art."

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

REWIRING THE NATIONAL CAPITOL WITH "SIMPLEX."

The Simplex Electrical Co. of Boston has again strengthened its position in Washington, with the national authorities by securing the contract to furnish the wire that is to be used for the rewiring of the United States Capitol—one of the largest buildings in the world. This important contract may be said to supplement that which the Simplex Co. carried off last year for the wire to be used in the enormous new building in Washington for the Congressional Library, where the work has now been practically finished.

G. E. APPARATUS FOR BULUWAYO, S. A.

Less than two years ago Buluwayo was a thatched town in South Africa, inhabited by a war-like Zulu tribe under the savage Lobengula. A few months only has sufficed to turn the kraal into a busy city which has sprung up with mushroomlike rapidity. It has just ordered from the General Electric Company, an electric lighting plant for the illumination of its streets, public buildings and private residences. This contract was captured in the face of the competition of the most noted manufacturers in Europe, whose foothold in South Africa was the surer, because it had been planted earlier and had been undisputed. The contract was secured entirely by correspondence and solely on the merits of its engineering plans and recommendations.

The plant will consist of two McIntosh & Seymour engines, taking steam from Babcock & Wilcox boilers. The engines will drive two single phase high periodicity General Electric alternating dynamos. The lamps will come from the General Electric Company's works, and thus a representative American plant will be established on the newest frontier of the new civilization in South Africa.

ELLIOTT BROTHERS' INSTRUMENTS.

Elliott Brothers of London stand in the foremost ranks as scientific and electrical instrument makers, and during their long, successful career, have constructed apparatus for governments, cable companies, telegraph companies, colleges, universities and other users of high class instruments throughout the world. They have every facility for making apparatus to meet special requirements, and are always pleased to tender bids for such work, although instruments for almost any purpose can be selected from their regular types.

Among the most recent American orders received by the Elliotts are those from The Cataract Construction Co., Safety Insulated Wire and Cable Co., Mr. Nikola Tesla, Consolidated Telegraph & News Co., U. S. Naval Academy, U. S. Naval Observatory, Drexel Institute, State University of Iowa, Miami University, Cornell University, University of Chicago, etc.

The 1895 edition of their handsomely illustrated catalogue can be obtained promptly by sending 15 cents for postage, to Mr. James G. Biddle, American Agent, No. 522 Drexel Building, Philadelphia.

NATIONAL LEAD COMPANY'S PREPARATIONS.

The National Lead Company have issued a pamphlet in which the advantages of the red lead and linseed oil preparations furnished by them for the permanent protection of iron and steel are set forth. The Company has also published for the benefit of its customers, a treatise on babbitt or antifriction metals, in which the standard metals of the Company, babbitt bronze, genuine babbitt metal, No. 1 journal metal, sterling journal metal, per fection antifriction metal, bearing metal, No. 4 metal, and com bination metal, are described. Both pamphlets are good reading.

A BIG ELECTRIC PUMPING PLANT FOR APOLLO, PA.

A few days ago the *Herald* had the pleasure of announcing that to the Davis-Farrar Co., of this city, had been awarded the contract for the pumps for the great plant of the Apollo Iron & Steel Company, near Pittsburg, the service demanded being the pumping and delivering of 17,000,000 gallons daily. Now comes the gratifying intelligence that the electrical equipment for operating these pumps will be supplied by the Keystone Electric Co., also of this city, the contract being awarded them in direct competition with such great concerns as the General Electric Co., the Westinghouse Co., the Western Electric Co., and a dozen other prominent electrical manufacturing companies. The electrical equipment will embrace two 35-horse power, and three 50-horse power motors, and the contracts call for the completion of the entire equipment in 60 days. The pumping plant of the Apollo Iron and Steel Company will be, when completed, the largest, electrically-operated in the world, the largest now in operation being that of the Ohio Steel Company, at Youngstown, O., the capacity of which is 7,000,000 gallons daily, and which was also equipped by the two Erie concerns mentioned.—*Erie, Pa., Herald.*

THE CORRESPONDENCE SCHOOL OF TECHNOLOGY.

The above excellent Cleveland institution has been incorporated, and with the object of increasing its range of work, additional capital has been secured. The officers are: E. P. Roberts, president; Thos. Robinson, treasurer and J. C. Gallup, secretary. It will shortly issue a new prospectus.

THE MERITS OF RAINBOW PACKING.

The Peerless Rubber Mfg. Co., 16 Warren street, New York City, have received the following strong testimonial:

Northern Steamship Co.,
Great Northern Railway Line,
Steamship North Land.

September 12, 1895.

MR. CHARLES H. DALE,
President, Peerless Rubber Mfg. Co.,
New York City.

Dear Sir:—I have used Rainbow packing for steam and hot water pressure of 266 lbs. and 500 to 600 lbs. respectively, and find it superior to all others. Before using Rainbow packing I tried various other packings, including corrugated copper, and found that they would not hold. I therefore tried Rainbow packing and can cheerfully recommend it as being the only packing for all high pressures in the market to-day.

Respectfully yours,
HENRY J. REYNOLDS,
Chief Engineer, Steamship North Land.

TRIUMPH ELECTRIC CO.

THE Triumph Electric Co. of Cincinnati, O., find business very brisk. On some sizes they are several weeks behind orders, and on all sizes their usual stock is much reduced. They have recently placed four new multipolar generators in Chicago, and are at present installing two 65 K. W. direct connected machines in one of the largest shoe manufactories in Cincinnati. The demand for this class of apparatus has been exceptionally heavy. Their multipolar elevator motor, with new automatic controller, has received immediate approval and they have been utterly unable to keep pace with orders for this class of machines.

The Atlanta Exposition Company have some twelve of the Triumph machines of different sizes in use in their machinery department, besides which there is an attractive exhibit in the electricity building, where Mr. E. F. Seixas, their southern representative, is in charge and is doing well.

LEFFEL WHEELS AT NIAGARA FALLS.

James Leffel & Co., of Springfield, O., have contracted to supply 3 wheels to the Schellkopf Hydraulic plant at Niagara Falls to run under 210 feet working pressure, which is the largest head pressure for any turbine of any considerable size and capacity. These wheels are 5,400 H. P. nominal. The same firm are now building 4 of their Cascade wheels for 780 feet head. These operate on a different principle from the Leffel turbine. One of these wheels connects direct to the generator without belt or pulley, as do the Niagara wheels, which will drive 6 generators, one on each side of the 3 wheels, connected directly to the water wheel shaft.

THE NEW PLANT FOR MARTIN'S FERRY, W. VA.

Contracts have been let for the electric light plant. The Westinghouse Electric Company got the contract for the incandescent machinery at their bid of $3,196, it being the lowest. The Standard Electric company got the arc machinery and the outside construction at their bid of $12,205. This includes putting up the poles and wires through the town. Russell & Co., of Massillon, got the contract for the boilers and engines at $7,160. It is the understanding that this company should buy the boiler from Spence & Son, of Martin's Ferry.

Kerr Bros. got the construction of the plant, their bid being $4,473. This includes the excavation, stonework and building.

PRIZING THE DATA SHEETS.

"I value these sheets very highly and consider that they are worth more than you charge for subscription for the ENGINEER." H. C. Wybro, Los Angeles, Cal. "I failed to get this week's ENGINEER (Sept. 18); will you please be kind enough to send it. I would not miss a Data Sheet for ten times its value. They are the best thing of their kind published in this country, and are a great help to any electrical engineer." Paul A. Draper, Washington, D. C.

STANDARD PAINT CO.

Owing to the increased demand for "P & B" products abroad, it has become necessary for the Standard Paint Co. to establish headquarters in England. Mr. Ralph L. Shainwald, the president of the company, has sailed on this mission on the "St. Louis," and contemplates spending two or three months abroad, so that he can establish sub-agencies in the principal European cities.

MANHATTAN TELEPHONES.

The Manhattan Electrical Supply Co., of 32 Cortlandt street, New York, has just issued a neat little "Descriptive Pamphlet of Electric Telephones and Electrical Supplies." It is chiefly devoted to telephonic apparatus, including receivers, magneto transmitters and microphonic transmitters. There is also a vigorous review of some ten pages of the telephone patent situation, in which the Company expresses freely its views on current litigation and gives a number of helpful hints as to what can and cannot be made or used. Besides the telephone section of this brisk pamphlet, there is a variety of data about the Company's other supplies. It is mentioned that of their Mesco dry batteries 400,000 have been sold.

NEW YORK NOTES.

MR. E. J. WESSELS, whose interesting "Roundabout Notes" have run through our columns lately, has returned from his trip through Europe.

THE E. G. BERNARD CO., of Troy, N. Y., were visited by fire a few days ago, but it has not delayed them in shipments, and manufacturing is going on without interruption.

THE STANDARD AIR BRAKE CO., of 85 Wall street, have closed a contract to equip all the cars of the Nassau Electric road in Brooklyn with their air brake—64 cars in all—and the work is being actively pushed. They have also secured a further order for 10 additional outfits for the Pasadena and Los Angeles road.

THE BROOKLYN HEIGHTS RAILROAD CO., C. L. Rossiter, president, is to equip 500 of its cars with electric heaters, and has placed an order for 3,000 heaters with the Consolidated Car Heating Co. of Albany, N. Y. Mr. Rossiter informs us that it is not the intention to increase the generating capacity, as the power houses have plenty of reserve.

MR. E. W. LITTLE, Gen. Manager of the Interior Conduit and Insulation Co. of N. Y., promises to make at the coming convention of the Street Railway Association at Montreal a very comprehensive and interesting exhibit of their new Underground Feeder System for street railway service they are about to place upon the market.

MR. JOSEPH DE RYCKE, manufacturer of steam specialties, Munroe-Taylor Building, this city, has issued an extremely handsome catalogue, well put together and well illustrated. It deals exhaustively with his excellent centrifugal steam separators, grease extractors, exhaust heads, condensing exhaust pipes, steam pump governors, feed water heaters, &c., giving cuts and clear descriptions. There is a long list of users, and the testimonials are unequivocally strong.

BLAKE & WILLIAMS, steam and electrical engineers and contractors, of this city, report that they have closed contracts for a complete electric light installation for the new terminal station of the New York and Brooklyn Bridge; a complete electric light, power and heating installation for the Syndicate Building, corner of Liberty and Nassau Streets, New York City, and a complete electric wiring installation for the Gerken Building, corner of West Broadway and Chambers Street, New York City; also complete electric installations in the Grammar schools at 119th Street and Madison Avenue; at 82nd Street and West End Avenue, and at Christie Street near Delancy Street, New York City.

THE STANDARD PAINT CO., of New York, have just got out a number of handsome new catalogues of their various specialties, chief amongst which is the old favorite P. & B. paint. The P. & B. book describes its various uses, and it is wonderful what a varied use this valuable article can be put to in addition to its general adoption for electrical insulating purposes. It is used for brick work, by brewers, by cider and vinegar manufacturers, for boats and barges, in coal mines, by copper refiners, distillers, for packing houses, for all kinds of iron work, for ice machines, for water works, and indeed for almost any place where a preservative is required. The rest of the book is taken up with testimonials bearing witness to the excellent service rendered by P. & B. paint, and the whole makes an interesting little pamphlet which all interested should send for.

They have also got out a little pamphlet descriptive of their Ruberoid Roofing, which contains all the excellent qualities of P. & B. paint and which is put up in convenient form for roofing purposes, and which might well be used when designing electric light and railway stations.

NEW ENGLAND NOTES.

PROVIDENCE, R. I.—The Fort Wayne Electric Corporation has received a contract to furnish the Narragansett Electric Co., of Providence, R. I., with sixteen 125 arc light dynamos of Mr. J. J. Wood's latest and best make.

THE PERKINS ELECTRIC SWITCH & MFG. CO. has just issued a blue catalogue of its Waterhouse, Gamble & Co.'s arc lamps, of which it has the manufacture and control. The catalogue is freely illustrated and contains a large amount of useful information on the subject of these specialties.

THE BERLIN IRON BRIDGE CO., of East Berlin, Conn., have just completed for the Geo. W. Stafford Mfg. Co., Providence, R. I., a new machine shop 50 ft. wide and 174 ft. long, two stories high. The building is constructed of brick and iron and is so designed that two additional stories may be added in the future. The same company have also just completed a new car barn for the New Haven Street Railway Co., the barn being 86 ft. wide and 188 ft. long. The roof is covered with slate.

PHILADELPHIA NOTES.

THE UNITED ELECTRIC IMPROVEMENT CO. of Philadelphia, has bought out the Livgro Incandescent Lamp Co. and is now making lamps, it is stated, with the plant, which it has removed to its own factory.

MR. JOSEPH W. LUCAS has opened an office at No. 822 Race St., Philadelphia, as supervising and consulting electrical engineer. Mr. Lucas has had six years of practical experience in the construction of electrical apparatus and contracting work, and is prepared to draw up full specifications on all work of an electrical nature, and to supervise, personally, the installation of such work.

ELECTRIC LIGHT COMBINE.—The rumored intention to consolidate the Edison, Powelton, Suburban, Manufacturers and Diamond electric lighting companies is denied, but is still talked about. The total capitalization of the companies named is as follows: Edison, $2,000,000; Suburban, $800,000; Diamond, $250,000; Manufacturers (paid in), $203,560; Powelton, $450,000; Columbia (paid in), $66,000. The officials of several of these companies denied any knowledge of the deal, but it is said that the matter of organizing the company has been placed in the hands of a broker in this city.

WESTERN NOTES.

PROF. B. F. THOMAS' report on Packard lamp tests has just been issued in pamphlet form.

THE CARD ELECTRIC CO., Mansfield, O., has installed a 150 H. P. generator in one of the local factories.

SARGENT & LUNDY, the Monadnock, Chicago, have opened a drawing office at 519 Boylston Building.

MR. H. J. MEDBERY, president of the Fiberite Co., Mechanicville, N. Y., paid a short visit to Chicago last week on important business, of which more may be heard later.

THE CHICAGO EDISON CO. are getting out a catalogue of the electrical supplies and specialties which they handle, and as it is now in the hands of the printer, they hope to have copies ready for distribution shortly.

THE ELECTRIC APPLIANCE COMPANY as general western agents for the Grutting electric heating appliances are offering something very fine in the line of an electric soldering iron, and an electric curling iron heater. They have some interesting circulars on these goods, going considerably into detail, which they will be glad to furnish on application.

C. E. WOODS CO.—Owing to the greatly increased volume of business the C. E. Woods Co., Chicago, have found it necessary to enlarge their quarters for the accomodation of their drafting department, and are having a commodious and elegant suite of rooms fitted up for them at 1315–1316 Monadnock Block, into which they expect to move within the next few days. They are also opening branch offices at New York City and Tokio, Japan, in order to be closer in touch with their clientage at those points.

THE METROPOLITAN ELECTRIC COMPANY wish to state that they have been delayed in delivering their catalogue as promised, on the first of the month, on account of additional matter that has come up which will increase the book to 700 pages. It is a monster edition and will be, they say, the largest and most complete electrical book in the world. It is now expected that it will be ready for distribution October 1st. The Metropolitan Company report very large orders for P. & B. tape and for the Metropolitan incandescent lamp.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE

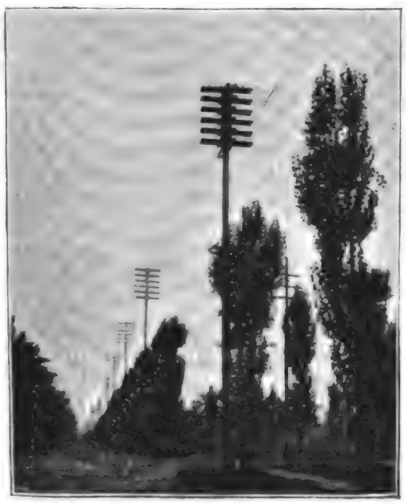
Electrical Engineer.

Vol. XX. OCTOBER 9, 1895. No. 388.

POWER TRANSMISSION.

THE PORTLAND, ORE., LIGHT AND POWER DISTRIBUTION FROM THE WILLAMETTE FALLS.

THE PORTLAND GENERAL ELECTRIC CO.



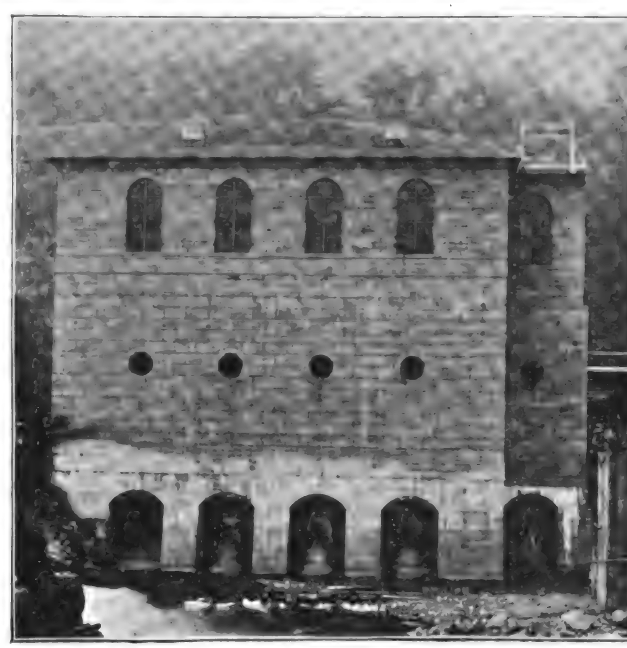
The Transmission Pole Line.

THE work of utilizing the great water powers of the far West is going on rapidly. Within the past month two electrical plants for the transmission of power from waterfalls over long distances have been installed. That at Sacramento, Cal., has proved the feasibility of economically transmitting the power of a fall to a distance of nearly twenty-five miles. That at Portland, Ore., is still more important and presented many new electrical problems. These have been successfully solved and the thriving city of Portland is now benefitting by a service of electricity from a water-fall more than twelve miles away.

This installation was made by the Portland General Electric Co., of which Mr. P. F. Morey is president. The Company owns the entire water power of the Falls on the Willamette River at Oregon City, twelve miles above Portland, which, with a head of forty feet, has a minimum capacity estimated at 50,000 H. P. Part of the power has already been utilized by numerous factories and mills erected near by, and in addition to these an electric station erected some years ago has supplied current for lighting the streets and dwellings of Portland and for operating an electric street railway between Oregon and Milwaukee, seven miles away, the direct current and high frequency alternating systems being used.

POWER HOUSE AND INTAKE CANAL.

In order to take advantage of the power of the Falls, the Portland General Electric Company has constructed the first part of an extensive station on the west side of the Willamette River opposite the City of Oregon. The part constructed is one quarter only of the building, which is



POWER HOUSE—SHOWING TAIL RACE.

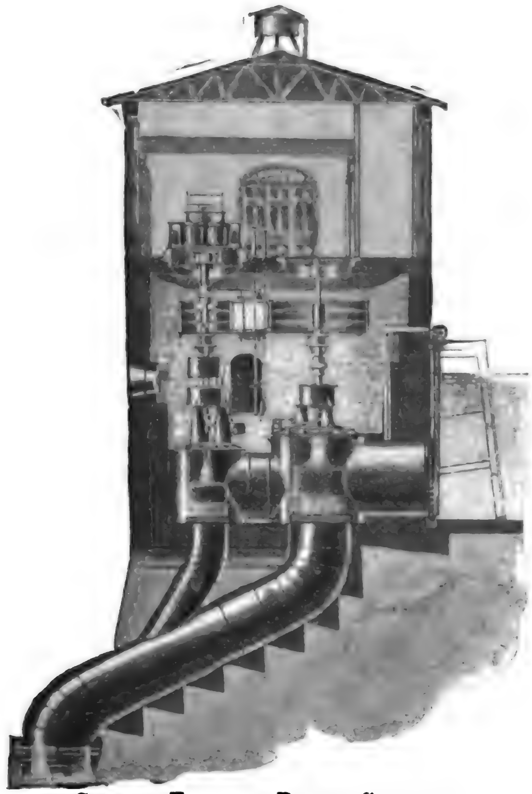
being put up in sections. Twenty sections will complete the building; five are already built and foundations are now being laid for the remainder. The ultimate generating capacity of the station will be 12,800 horse power.

In addition to the land covered by the station, the Portland General Electric Company has purchased about 1,600 acres in the vicinity. It also controls the canal and locks on the west side of the river, constructed to allow of the passage of vessels past the Falls into the navigable waters above, extending seventy-five miles inland. To construct this canal, the State of Oregon contributed about $200,000, the remainder being supplied by the Portland Company.

THE TURBINES.

The station building is of concrete, stone, iron and brick, and when finished will have a length parallel with the river of 364 feet. The water is taken from the canal, led through an extensive hydraulic installation and discharged into the river below on the other side. The

water wheel plant is from the works of the Stillwell-Bierce & Smith-Vaile Co., of Dayton, O., and consists at the present time of three units, each consisting of a pair of vertical cylinder gate, improved Victor turbine wheels,



SECTION THROUGH POWER STATION.

42 inches and 60 inches in diameter, respectively. The larger wheel is an auxiliary to be brought into service only at periods of excessive high water, which the records show occur about once in every five years. The smaller wheel runs at a speed of 200 revolutions per minute, and the larger at 100 revolutions per minute. Both turbines are set at the same level and each carries a pulley; that of the 60-inch wheel being fixed to the generator shaft. When the large wheel is in operation the two pulleys are belted together, the smaller wheel is disconnected and the large wheel drives the generator at a uniform speed of 200 revolutions. When the smaller turbine is operated alone, the belt lies upon a shelf surrounding the pulleys.

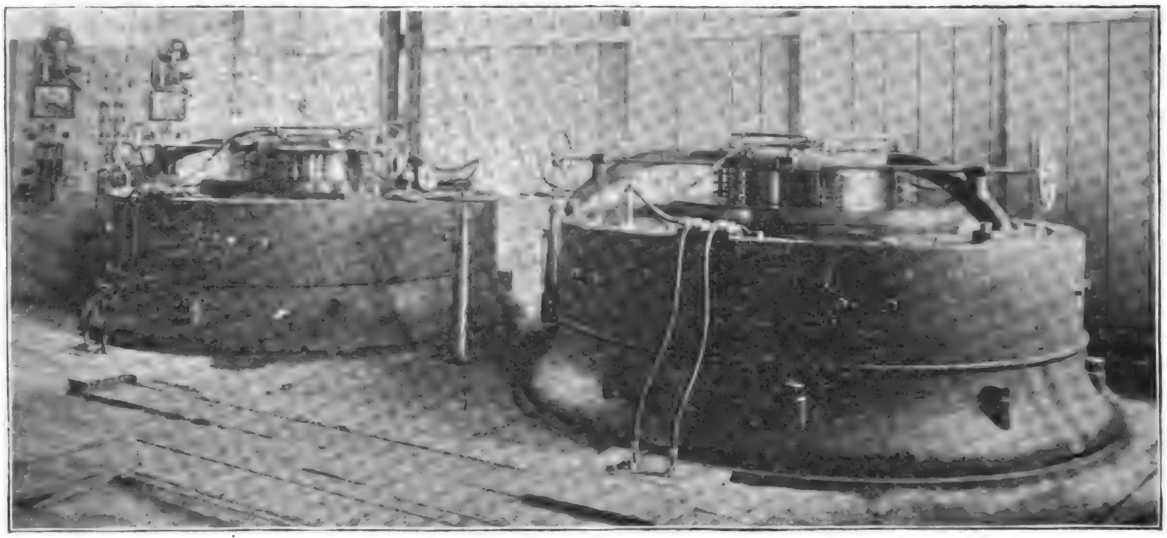
The weight of the vertical shaft with the armature is about 33,500 pounds and to carry this a system of extra bearings is introduced, one of the ring thrust type and the other a hydraulic oil bearing, both supplementing the ring bearings on the armature shaft. They are enclosed in cases filled with oil delivered by hydraulic pressure, and are surrounded by water jackets

The length of the generator shaft is 29 feet and 8⅝ inches in diameter. It is not a continuation of the shaft of the wheel but is coupled to it by means of a disc coupling, which allows of a certain free movement, up and down, of the generator shaft. The shaft of the 60-inch wheel runs from the coupling to a bearing set in the floor of the station. Both wheels in each section are controlled by hand wheels and both are regulated by the same governor. The belt tightener is also controlled from either floor by a hand wheel.

The water is admitted to the penstocks from the upper canal by means of a head gate operated from a platform on the canal side of the station. Each penstock is ten feet in diameter and is constructed of riveted steel plates. Each wheel has its own flume, the water passing first through the large flume of the larger wheel to the flume of the smaller wheel, whence it passes through a tube into the tail race. In addition to this turbine equipment, an auxiliary power equipment has been furnished, consisting of a set of pumps, including a hydraulic pump for supplying oil to the thrust bearing cylinders and a duplex water pump to circulate the water in the cylinder water jackets. They are operated by two 15-inch horizontal turbines enclosed in the same flume.

For the operation of the exciters a further pair of vertical turbine wheels has been installed, each 48 inches in diameter, driving the generators by a system similar to that already described for the operation of the main machines. The complete power plant will consist of

INTERIOR OF POWER STATION SHOWING 3-PHASE GENERATORS AND DIRECT CURRENT EXCITERS.



VERTICAL EXCITING GENERATORS IN POWER HOUSE OF THE PORTLAND GENERAL ELECTRIC CO., AT WILLAMETTE FALLS.

twenty three-phase generators and two direct current generators, acting as exciters. The total capacity of the station, therefore, will be 12,800 horse power, divided into twenty units, each one independent of the other.

THE SYSTEM OF DISTRIBUTION.

In order to obtain the best results from the power at its disposal, the Portland General Electric Company selected the three-phase system of electrical power transmission as developed by the General Electric Co., which has proved satisfactory in a large number of power transmission installations of varying sizes and varying distances in this country.

One peculiar feature of the Portland installation is the employment of large blocks of power for street railway service, involving the transformation of the polyphase current sent over the line into direct current for railway circuits. The frequency is 33 cycles per second, selected on account of the large amount of power which it was necessary to convert from alternating into direct current. The current is delivered directly to the line without first passing through transformers and when it reaches Portland is transformed down to a potential of 400 volts. For the power service the step-down transformers are connected to rotary converters which will deliver a continuous current of 500 volts for street railway service, as well as for the operation of stationary motors. Induction motors will also be used directly connected to the secondaries of the step-down transformers when this can be done to advantage.

The five sections of the building already erected are occupied in the following order. The first section contains the pumps and the accumulators for the complete station; in each of the three following sections is one three phase alternating current generator of 450 K. W. or 600 H. P. capacity, and the fifth section contains two 250 K. W. MP. continuous current generators used as exciters. Each exciter is capable of exciting all of the twenty three-phase generators, and the second has been set up as a reserve in case of accident to the first. At present, one is furnishing direct current to the street railroads in Oregon City. When the station is complete, the exciter section will be removed from the fifth section, which it occupies at present, and will be placed in the centre section of the building, where the switchboards will also be erected.

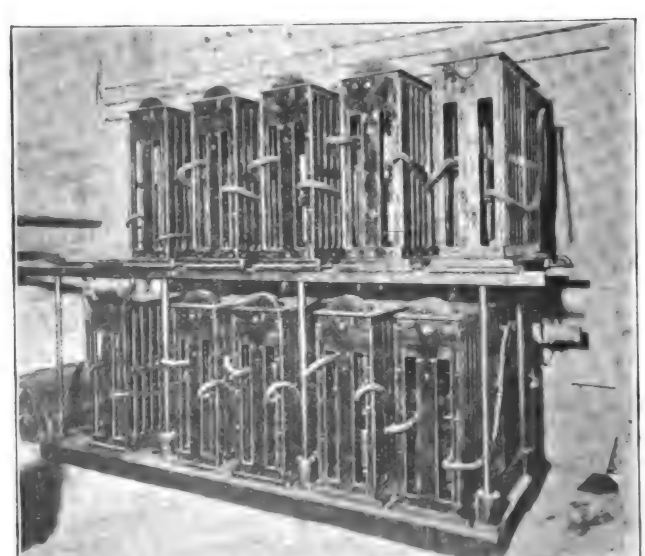
THE GENERATORS.

The generators are of special design and are set upon the floor of the station, the armatures revolving in a horizontal plane, with one bearing at the floor line and another on top of the armature underneath the collector rings. Each generator has twenty laminated poles. The armatures are a little over seven feet in diameter and are about two feet high. These armatures are constructed to deliver current directly to the line at a working potential of 6,000 volts effective pressure without the intermediation of step-up transformers. On account of this high voltage, unusual precautions were necessary to perfect the insulation of the armature coils to avoid leakage to the ground. The armatures are wound with flat wire and each of the coils is divided into sections, each section being separately insulated. The thoroughness with which the feat of delivering the enormous voltage direct from the machine has been accomplished can be judged by the fact that the armatures were subjected to a pressure of 15,000 volts alternating and were both short circuited and open circuited under full excitation without the slightest injury.

The field coils are wound for excitation of 500 volts continuous current and each has been subjected to a test of 5,000 volts alternating. The regulation in these machines has proved singularly good, the increase from no load to full load being comparatively moderate.

From the dynamos the leads are run to floor connectors and pass underneath the floor to the switchboard. The concrete floor is laid over them and thorough protection thus guaranteed.

The exciters are set up to allow of the armature revolv-

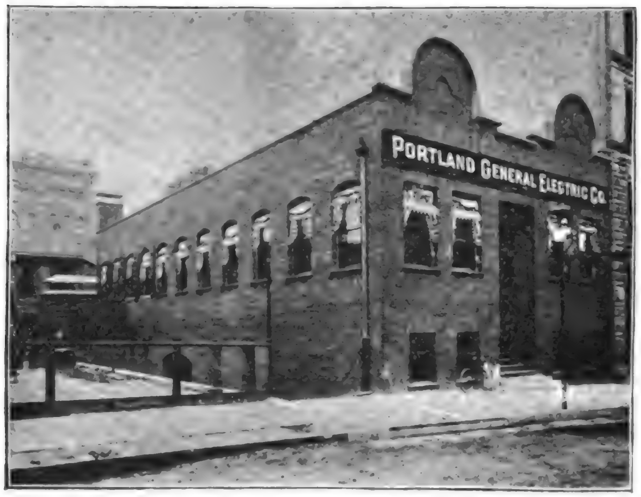


THE POTENTIAL REGULATORS.

ing in a horizontal plane with one bearing only at the floor line. The construction of these exciters is almost identical with that of the General Electric M.P. railway generator, and each has a capacity of 250 K. W. at 125 revs. per minute.

THE SWITCHBOARDS.

The high tension switchboards are built of native marble and the panel method of construction is followed throughout. Each panel carries a double pole main switch for the high potential circuit and a double-pole double-throw switch for the exciting circuits. It also carries a rheostat for the control of the excitation of each machine and a single throw switch opening the circuit through a set of seven 32 C. P. 110 volt lamps. In addition, the board carries a current indicator for each line and one for the exciting circuit, and a potential indicator with station transformer placed at the back. The upper part of each panel consists of a set of plug connections for coupling the machines in parallel or for direct line connections from each generator.



THE SUB-STATION AT PORTLAND.

The exciter switchboard consists of two panels of Tennessee marble with a special switching panel between them. By means of this switching panel, current for the railway service in Oregon City can be obtained from either exciter, or the two exciters can be coupled in parallel or the outgoing railroad current can be used for excitation purposes and the remainder from the exciters can be used for other work.

THE LINE.

From the generators the current passes directly to the line through the switchboard. The line is 14.3 miles long, a separate circuit being installed for each machine. It passes through an undulating country following the course of the Willamette River as closely as possible. The poles upon which the three-phase wires are strung, also carry a number of wires for the 5,000 volt continuous arc current from the old transmission station, as well as the wires over which the old system of lighting with high frequency 5,000 volt alternating current is effected. The loss in the long distance transmission line is calculated at full load at about 11 per cent.

THE SUBSTATION AT PORTLAND.

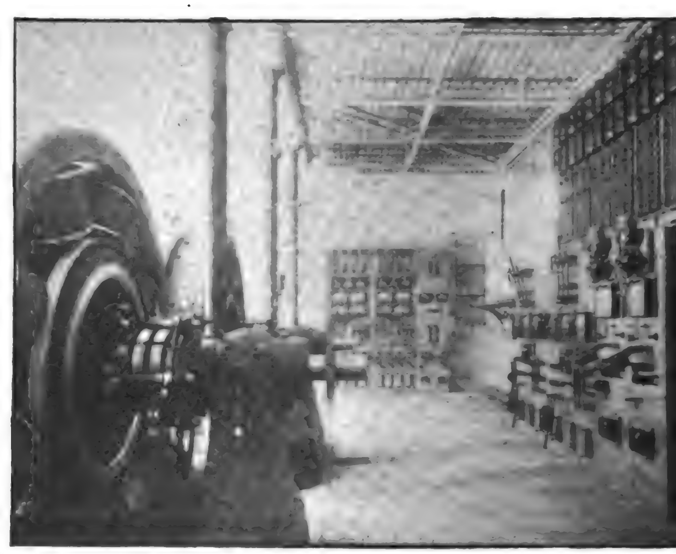
The substation to which the high frequency lines are brought, is a two story building at the corner of Seventh and Alder Streets, covering a space of 40 feet by 100 feet. The lower floor is divided into three rooms, one containing the transformers, the second the rotary converters, the other being used for a repair shop, lamp and meter room. The upper story of the building is occupied by the offices.

In the transformer room at present are the necessary transformers for the three units already installed, or 45 transformers in all. The receiving end of each line is connected to a bank of 15 transformers per generator, five being placed between each pair of wires of the three-phase system. The transformers are mounted on an iron rack five transformers high and three wide and foundations are already laid for six additional units. Each set of five transformers is connected to the primaries in series and to the secondaries in parallel, although in the transformation of the three-phase current two sets only are necessary. For the large units, with high voltages, however, as employed in the present installation, it is desirable to have a large number of transformers banked. The bank, therefore, is divided into three sets instead of two, so that each group may act as a reserve to the other two sides, enabling two-thirds of the power of each generator to be delivered, even if the transformers on one leg of the circuit have to be disconnected; nor is the balance of the system affected by this change of connection. The transformers regulate at a little over one per cent. variation of the secondaries from no load to full load. The transformers are of the standard General Electric sub-station type, having numerous air passages between successive bunches of iron laminæ and between the coils so that they may be cooled by artificial ventilation. This enables the transformers to be worked at a high output and efficiency and yet remain cool.

THE DISTRIBUTION AT PORTLAND.

The distribution of light from the secondaries is effected on the Edison four-wire system, which allows of a large territory being operated from one transformer station and which also allows of the working of synchronous and induction motors from the lighting mains. The four-wire system is worked at 1,000 volts between wires and by means of feeder regulators a variation of 4 per cent. in either direction is covered.

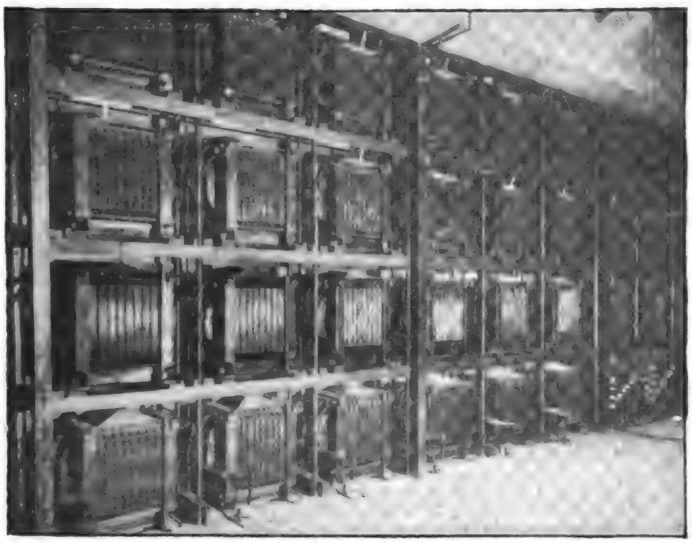
As already mentioned, the direct current for the railway service is obtained by conversion from the three-phase alternating current. This is effected by means of rotary transformers, a type of machine which the General Electric Company has brought to a high state of perfection. Two of these are at present installed in the sub-station and space has been left for an additional three. The capacity of each converter is 500 H. P. delivered to the bus bars of the continuous current switchboard.



THE 3-PHASE SIDE OF THE ROTARY CONVERTERS.

The long distance transmission lines for this railway service, as in the case of the lighting circuits, are connected to step-down transformers, transforming the current from 6,000 volts on the line to 400 volts at the secondaries. The secondaries are connected to the three collector rings

on one side, and the current is thus brought into the armature of the rotary converter. The alternating current at 400 volts is then converted in this machine into direct current at 500 volts at no load and 550 volts at full load delivered from the commutator side. The rotary converters are arranged for self regulation, the voltage on the direct current side compounding with the same regularity as that found in the best current dynamos, despite the varying losses on the long distance line and the varying armature reaction in the rotary converter. This regulation is entirely independent of the generator, which receives constant excitation at all loads. The shaft of the rotary converter is extended twelve inches beyond



THE REDUCING TRANSFORMERS.

the bearing of the alternating current side to take a small pulley from which any small machine or an arc dynamo may be driven. It is a noteworthy fact that in spite of the long transmission line, and the increasing load on the generator, the potential supplied to the railway lines steadily rises as the load is increased. Each rotary converter has a capacity of 400 K. W. It is an eight-pole machine making 500 revolutions. The armature is iron clad, carrying at one side a commutator and at the other three collector rings.

THE SUBSTATION SWITCHBOARDS.

From the rotary converters the wires are taken to the power switchboards. Each converter has two panels, one for the three-phase current and one for the continuous current. The alternating current panel carries two double-pole switches, one for connection to the converters and transformers and the other to connect the converter to a set of common bus bars. An additional main switch is provided to connect the rotary transformer and the panel itself which carries also a set of fuses, three current indicators and a potential indicator with a transformer reducing the potential from 3½ to 1. The continuous current panel is of the standard direct current railway type with automatic circuit breaker, and a current indicator added for the fields of the rotary transformer. The panels may be coupled in parallel on both the alternating and the continuous current side.

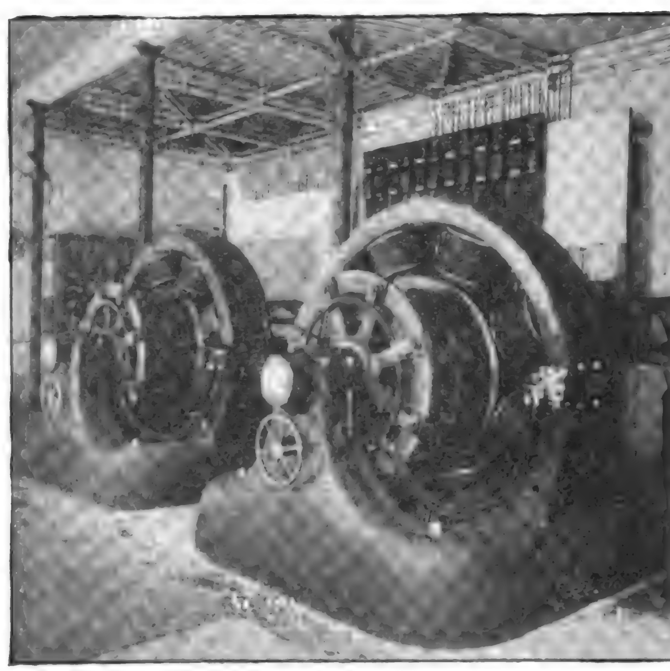
The lighting switchboards in the sub-station consist of one panel for each leg of the three-phase system. The secondaries from the transformers are entirely independent and the panels carry fuses and two 4-pole switches for coupling the feeders directly either to the corresponding transformer unit or to the bus bars and the switches for the operation of the feed regulators. A current indicator is placed on each side of the four wires and three potential indicators between the four wires. On top of the switchboards are placed the main switches for opening the different feeders, and each panel is provided with ground detectors and lightning arresters.

LIGHTING AND POWER.

At present the lighting from the three-phase system is used for large buildings, containing several hundred lights each. They are close to the city station and this distribution can be readily handled at about 400 volts. For the outlying and residential districts the high frequency apparatus with individual transformers will still be employed. Continuous current will be furnished to the railway and to the stationary motors already installed, but new motor installations will be made with the three-phase motors which will be run straight from the three-phase switchboard, in parallel with the rotary transformer.

The direct railway current will be carried to the East Side Railway Station by means of cables under the Willamette River and this distribution will reach as far as Milwaukee, where connection will be made in parallel with the 600 volt service from either station A or station B at Oregon City. The loop from Oregon City to Portland and back will thus be as follows: Beginning at Oregon City with 33 cycle three-phase current at 6,000 volts 14.3 miles will be traversed as far as Portland; the current will then be transformed to 400 volts alternating and passing through a rotary converter, issue therefrom at 600 volts continuous which will be transmitted eight miles to Milwaukee and connect with the continuous current from Oregon City.

This plant when finished will be one of the largest long distance transmission plants in the world. Its satisfactory operation so far shows admirably, not only the effectiveness of the three-phase transmission system for general service, but also its feasibility. This has rendered possible its adaptation to the operation of important railway systems through simple apparatus, and to the working of a distributing net work composed in a large part of existing lines.



DIRECT CURRENT SIDE OF ROTARY TRANSFORMERS.

CURRENT FOR THE PITTSBURGH REDUCTION CO. AT NIAGARA.

The Pittsburgh Reduction Co. is using current from the two-phase power house at Niagara through rotary transformers that deliver the direct current necessary for its process. The follow-

ing special dispatch from Niagara Falls of Sept. 24, is therefore interesting if true: The Pittsburgh Reduction Co. has closed a contract with the Niagara Falls Hydraulic Power Manufacturing Company for 3,000 horse-power, delivered on the shaft of the turbines to be placed under the high bank by the Hydraulic Company. It is said this power is to be furnished at a remarkably low figure. The Reduction Company will install upon these turbines direct current generators, the current from which will be used for the manufacture of aluminum. This is an important announcement for the Reduction Company, which has talked of using 25,000 horse-power at Niagara Falls for the manufacture of aluminum, because it gives them the practical control of all the present available cheap power which might, in the hands of a rival company, be used in competition with their product. It is understood that the furnaces will be placed in a building under the high bank.

ALTERNATING VS. CONTINUOUS CURRENT DISTRIBUTION AT NIAGARA FALLS.

BY J. C. HENRY.

The controversy on this subject from the *London Times*, published in THE ELECTRICAL ENGINEER of the 21st ulto., is of a spicy nature, and the slaps at Lord Kelvin seem to be discourteous and out of place.

The scheme to utilize the power of Niagara for electric purposes was, I believe, first given prominence by Lord Kelvin, when some 16 years ago he appeared before a Committee of the House of Commons and talked on the subject of long distance electrical transmission. Taking the power from Niagara Falls as an example, later in his inaugural address before the British Association in 1881, he went more into the details of the scheme and explained how this enormous force might be controlled and utilized in New York City. A continuous current was to be generated at the Falls, an electrical pressure of 80,000 volts was to be used to charge 40,000 accumulators in New York. These were to be switched on to the local circuits in sets of fifty.

I know of no theoretical objection to this scheme. It possesses many advantages over the alternate current system which has recently been constructed. I need mention but a few of them. First, temporary derangement of the generators or long circuits would not affect the consumption circuits. Second, the load on the dynamos and supply wires being constant, their size and cost would probably be not over one-third of those of the proposed plant. Third, the potential and kind of current desired by the consumer could be secured *for any desired purpose* without transformers or rectifiers.

In the *Times* controversy referred to, Silvanus P. Thompson says: "Lord Kelvin's prepossession in favor of continuous currents as against alternate currents is not supported by modern electrical practice, save for the restricted purpose of electrolytic decomposition. On the contrary, for *nine-tenths* of all other purposes the advantage is found to lie on the side of the alternate currents wherever the distance of transmission exceeds a few hundred yards."

As Prof. Thompson's correspondence refers to an American installation, I presume he refers to American practice. His figures are wide of the mark; about seventy per cent. of the entire current generated in this country is used to operate electric railway motors, none of which could use alternate currents; ninety per cent. of the arc lights used in America require direct currents. In New York City the Edison Co., which uses the direct current, seems to pay better dividends than those using the alternate current. The present Niagara plant will doubtless be a theoretical and commercial success; should it fail, the company have other resources, among them the fascinating scheme suggested by Lord Kelvin.

NIAGARA POWER ON THE ERIE CANAL.

A special dispatch of Sept. 29 from Niagara Falls says: A large number of the Directors and stockholders, with the officers of the Cataract Construction Company, are at the Cataract House, and will make their annual inspection of the big power works to-morrow. The party includes John Jacob Astor, Francis Lynde Stetson, Edward D. Adams, D. O. Mills, William B. Rankine, George S. Bowdoin, Charles Lanier, Edward A. Wickes, John Crosby Brown and Frank K. Sturgis, all of New York.

After the tour of inspection an important business meeting will be held. It is noised about the hotel corridors to-night that the directors will probably pass favorably upon the further development of the electrical power to supply other contemplated manufactories and conduct electrical power to Depew, in which some of the directors of the company are interested.

William B. Rankine created no small sensation to-night by giving out over his signature and with the complete indorsement of all the officers of the company and the Board of Directors a complete denial of the statement that the Cataract Construction Company, or its ally, the Niagara Falls Power Company, was interested in Frank W. Hawley's scheme of electric trolley propulsion for canal boats. It seems that statements had been made, emanating presumably from headquarters, that these companies were back of his scheme. Dispatches to that effect have been been sent out from Chicago, New York, Rochester, Buffalo and Tonawanda from time to time.

Mr. Rankine further said that if Mr. Hawley or his company desired to purchase power of the power company they were perfectly agreeable to sell, but to create the impression that the power company was in it with Mr. Hawley was erroneous.

ELECTRIC POWER WORK AT SPOKANE, WASH.

The Consumers' Light & Power Co. of Spokane, Wash., John B. Fisken, supt., is now engaged in the construction of its station and expects to go into operation with it in about six weeks. The capacity for the present will be two 150 K. W. monocyclic generators made by the General Electric Co. The wheels for developing the water power are being made by James Leffel & Co., and the water wheel governors by the Replogle Governor Works. The wheels are operated under 48 feet head. Power is to be furnished to a new flour mill for the Northwestern Milling & Power Co., of Spokane, and to the new Phœnix saw mill owned by the same concern.

ELECTRIC LIGHTING.

FROM COAL PILE TO THE METER.[1]

BY JAMES MILNE.

THE author presented an interesting series of curves calculated from different sources, showing the efficiency of the various parts of a generating plant. These results, expressed in percentages, are given in tabular from below.

Power for running generators........	100
Power available at switchboard......	92
Power available at meter...........	78.20

Efficiency of the electrical apparatus, including outside circuit = 78 1-5 %.

Engine............................	100
Available for generating current.....	83.3
Available at switchboard.............	75.72
Available at meter......	64.35

The commercial efficiency from engine to meter is 64.35%.

Boiler equivalent...	100
Indicated H. P. at engines............	7.04
Available for generating current.....	5.79
Available at switchboard............	5.33
Available at meter...................	4.53

The efficiency therefor from the boilers to the meter is 4.53%.

Coal pile equivalent.................	100
Available at stop valves of boiler.....	62.47
Indicated H. P. at engine.............	4.4
Available for generating current.....	3.62
Available at switchboard............	3.33
Available at meter...................	2.83

We see, therefore, that the electrical end shows up exceedingly well. For every 100 H. P. at the engine, 82.3 are utilized for generating current, and 75.77 of these are sent out to the line, which, although it could be improved on, leaves very little to be gained by any new invention or alteration that may hereafter be made.

STEAM HEATING FROM PITTSFIELD, MASS., STATION.

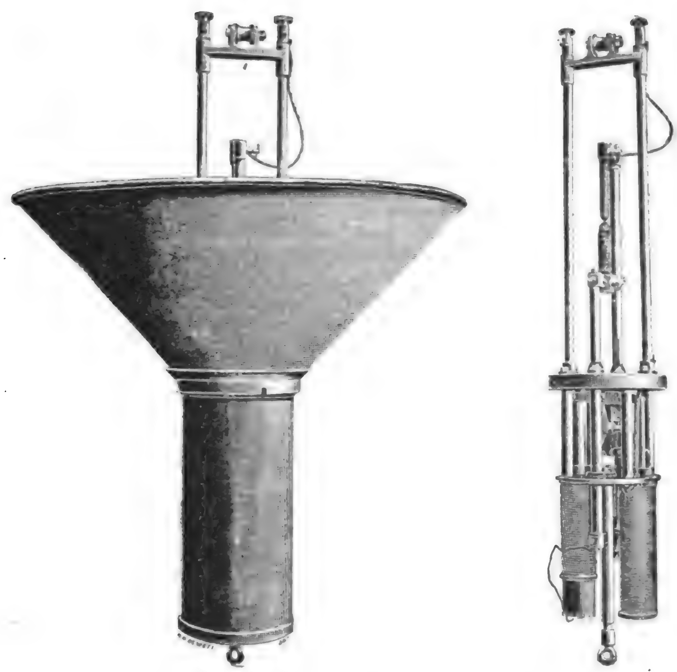
The Pittsfield, Mass., Electric Company is perfecting plans for furnishing steam heat for many buildings in the vicinity of its plant. The company has for some time been heating The Eagle building, the shop and office building of the Stanley Electric Manufacturing Company and the tack factory on Pearl street, and the success which has attended its efforts has led to the extension of the business.

The company's plan is to put a 12 inch pipe through all the blocks on the east side of North street between Cottage Row and Fenn street, and to heat all of them, if the owners or tenants so desire. The Methodist church is also to be taken on the circuit and heated. The company has a large amount of exhaust steam, and can just as well use it as not for heating purposes. If it gives as good satisfaction in other buildings as it has in The Eagle building there will be no cause for complaint.

1. Abstract of a paper read before the Canadian Electrical Association, Ottawa, Sept. 17, 1895.

INVERTED ARC LAMP FOR INDIRECT LIGHTING.

The accompanying engravings, taken from *Engineering*, illustrate an arc lamp constructed by Mr. A. W. Richardson, of Skew Bridge, Worsleyroad, Patricroft, near Manchester, England, and intended for lighting workshops by the indirect method, in which the light of the lamp is, by means of a reflector, thrown up first to a whitened ceiling, the body of the room being illuminated only by reflection from this. The system in question has hitherto found more favor on the Continent than in England, though a very satisfactory quality of light can be obtained, there being an absence of glare, and of the strong shadows, which often prove trying to the eyes, when direct lighting is used. The general appearance of the lamp as fitted up ready for use is wel.



FIGS. 1 AND 2.—INVERTED ARC LAMP.

shown in Fig. 2, while Fig. 1 shows it with its reflector and cover removed, thus allowing the arrangement of the working parts to be made out. The reflector is of enameled iron, and for a 10 or 20 ampere lamp measures 7 in. in diameter at the bottom by 25 in. at the top. The feeding of the carbons is regulated by a differential brake. Each carbon-holder is prolonged into a rack, and these racks gear with, but on opposite sides of, a single spur-wheel. Hence, if the carbons approach or recede from each other, this wheel must rotate. The motion of this wheel is, however, controlled by a magnetic brake, which comes into action as soon as the arc is working properly, releasing the wheel again and letting the carbons approach, whenever the current between the carbons falls below its normal intensity.

THE MOVEMENT FOR STANDARDIZING LAMP SOCKETS.

The subject of the reduction in the number of lamp sockets now in use, requiring the manufacture of special incandescent lamps with corresponding bases, has recently been discussed by the electrical press; and standardizing has been recommended in the cause of simplicity and economy. We are in receipt of a number of communications relative to an editorial in THE ELECTRICAL ENGINEER on this very important topic and give space to them below, representing the views of large users, supply houses, and the manufacturers. Discussing the question from the standpoint of a large consumer, MR. C. R. HUNTLEY, of the Buffalo General Electric Co. writes us:

"It is really too bad that there is such a number of lamp sockets in use at the present time. To the maker and seller of lamps it is decidedly expensive, as to both parties it necessitates an enormous stock of lamps to fit the various sockets, and it must be complete to encompass the range of voltage which we find thoroughout installations both from central stations and in isolated plants. We for two years have advocated, and wherever we could insist upon it, the use of the Edison socket. They are cheaper and seem to be better than the Westinghouse. The Thomson-Houston socket of course is very much better than any of them but its expense both for lamp base and socket is very much in excess of the others,—all of which you have made very plain. You can count upon me as advocating what you suggest to at least confine it to two types of sockets."

MR. J. POTTER, president of the Buckeye Electric Co., of Cleveland, makes the following noteworthy comment:—

"I note with interest your admirable editorial article in THE ELECTRICAL ENGINEER of Sept. 25th, upon the subject of Standardizing Lamp Sockets and agree fully with the views expressed in that article. I think it would be equally to the interest of all concerned, viz.: makers of sockets, lamp manufacturers, supply dealers and the user, that in the future only the standard Edison or Westinghouse socket should be installed; and trust that the agitation you have started will result in accomplishing, at least, as much as this. The Buckeye Electric Company is now charging a higher price for lamps fitted with other bases than Edison and Westinghouse, and I believe that all lamp manufacturers should adopt this policy."

MR. W. H. MCKINLOCK, president of the Metropolitan Electric Co. of Chicago writes us as follows:

"We will be glad to see the lamp sockets standardized and we quite agree with your editorial on the subject in your issue of the 25th. By having a standard socket (Westinghouse preferred on account of its economy and practicability), the economy in doing business would be marked from the standpoint of a supply house.

"We are obliged to carry a large assortment of lamps to fit all the various sockets, besides a large assortment of sockets, thus multiplying our capital invested in the ratio to the number of different sockets that are now on the market. If we had only one style of socket to deal in, we would have but one style of lamp base instead of the many now, and the liability of error would be lessened accordingly.

"The manufacture of electrical goods very largely should be standardized and with very material advantage to the business. The era of high prices has passed and we must get back to first principles in the conduct of the business to make it profitable to investors. The first step in this direction is to standardize the material used, and we can see no better medium than your paper for the promulgation of this doctrine."

It is not to be understood, that the sentiment is universally in favor of the more scientific standardizing of the socket. One of our correspondents, a large lamp manufacturer, does not, for instance, see eye to eye with President Rhotehamel, of the Columbia Incandescent Lamp Co.,—to whom the credit of the present agitation is in large measure due—but says:—"It has not worried us as much as it apparently has Mr. Rhotehamel. All bases, except the Edison, T.-H. and Westinghouse are rapidly being done away with. For the T.-H. we often get one cent extra so as to reimburse us for the extra cost. The number of Westinghouse bases used is also becoming smaller. The tendency undoubtedly is toward the adoption of the Edison style of base as a standard. In this connection, there is one thing that strikes me very forcibly, in fact alarms me. I understand that the Edison Company have in several cases sustained their socket patents. Now, what a huge joke it would be on us "little fellows" if the Edison screw base should become a standard, and then the General Electric Company should get out an injunction against our using it. I would be pleased to learn your view on this side of the case."

In keeping with this we have the terse objections of a socket manufacturer, who puts his points very cogently as follows:

"While we do not desire to have you publish writer's opinion on the question of your editorial last week, he would say that it does not meet with his approval. As the Westinghouse and Edison sockets cost ½ to 1 cent. more than the T.-H. socket, you can see that it is evened up on the question of bases; as the T-H. base costs ½ cent to 1 cent more than the Edison and the Westinghouse; but when you put the two together it is immaterial to us which base customers use."

We shall be glad to have comment from other readers in continuance of this discussion, which we deem valuable to the art and industry. The following from MR. ALFRED SWAN appears to us to sum up succinctly the general feeling on the subject:—

In having raised this question your journal merits the thanks not only of the electrical fraternity, more immediately concerned, but also the thanks of the public at large.

Now that exclusive rights to special types no longer obtain—now that the manufacture is generally free—there is surely no sense or reason in the continuance of the present diversity in sockets.

The argument usually urged against a proposed change, cites the "millions" of sockets of special type already in use, and instances the difficulty (as concerns renewals) that a change would involve in regard to those.

But, as against this objection, it should be borne in mind, that the millions of sockets now in use are as nothing when compared with the millions that *are yet to be used.*

A *standard socket* is bound, sooner or later, to ensue, and the sooner the better,—therefore, as you say, why not *now?*

This position being admitted, the question becomes simply a case of the "survival of the fittest," not, perhaps, the survival of

any of the present forms intact, but a survival (or rather a *revival*) in new form, of the best points of all combined.

A determining factor in the solution of the question will, doubtless, be the type or style of "base" employed, but this, in my opinion, applies more to the *form* than to the *cost*, of that "base" itself.

For instance, though the cost of the Thomson-Houston style of base (as at present made) is admittedly more than that of either of the other styles, yet it is a form that decidedly favors a simpler, safer and less expensive construction of *socket;* it is, therefore, these *two things* (the socket and base) considered as *one*, that must be taken into account.

Of course, in a discussion of this nature it is scarcely possible wholly to avoid comparisons which may appear odious.

The purpose of this letter is simply to initiate an unbiased discussion of the question, so opportunely raised by you, in the hope that such discussion may tend to put an end to the socket anomaly as it now exists and ultimately lead to the adoption of a standard worthy of acceptance as such by reason of its scientific fitness for its required purpose.

ELECTRIC TRANSPORTATION DEPARTMENT.

ARE WE LAYING TOO MANY MILES OF TRACK TO REACH A FEW PEOPLE?[1]

BY W. W. COLE.

It is an established fact that as the mountain would not go to Mohammed, he had to go to the mountain. The fact is just as self-evident in the location of track, that if you stop one block from where the dividing line comes, between the settled district and the open field, the people will walk that one block to the cars; and the maintenance and operation of 1,500 feet of track for one year on a fifteen minute headway, at nine cents per car mile, means the interest at 5 per cent. on $26,864, or $3.68 per day. It can be readily seen that with many lines extended just beyond the line of population, the road has extended just beyond the line of dividend. It is conceded by all that when a new line is constructed, we next have to educate the people to ride, as they have become accustomed to depend on their horse or bicycle, or to walk. Now, if we extend our lines beyond the population, we immediately become a professor of education, as we must not only educate the existing population to ride, but must educate the people to build on the open territory and educate people to move into the houses built. If we keep within the lines of existing population, we have the advantage of a general located on an eminence—we can wait and see which way the population army moves, and then we make no mistake in our extension. In other words, the railroad is practically the army sutler, and there is no instance where the sutler led the army.

There is no denying that a railroad extended into open territory will increase the value of real estate, and eventually build it up; but, in the mean time, we are wearing out rolling stock and track for the owners of real estate, and should receive a bonus sufficient to carry the road until the open territory is sufficiently populated to support a road. It is the general experience, that by the time the fields become populated, the rolling stock must be replaced, and the track repaired, or we practically build a new road to suit the new condition and outside of the benefit to the real estate owners, we only get our returns when the new road is built for the actual needs of the existing population. A road built in an unpopulated district has to contend with more dust and mud upon its rails, which means wear and tear, and without sewers there are bound to be places in the track where it will be covered with water, which is deleterious to motors, track and car bodies.

We will cite as an illustration a city of forty thousand inhabitants, which has twenty miles of track; five of the city lines extend 2,112 feet beyond the settled territory, or two miles of track with but little traffic. Taking an average of ten cities of forty thousand population, the riding per capita is forty-six times per year. This would give in gross receipts $92,000; operating expenses 70 per cent. of gross receipts, or $64,000; and $27,600 net receipts. The average road is bonded at the rate of $30,000 per mile, or $600,000 for twenty miles of track. The interest at 5 per cent. would be $30,000. This would show a deficit of $2,400 on interest.

Now, in this city of forty thousand inhabitants, we have two miles of track operated and bonded, that for the present we get no returns from, as it was built to promote the building of the city at different points, and like the man who has lived a good life on earth, we are looking forward to a future reward; but the man is invariably dead when he receives it, and the results of street railroading show that they are waiting for the sound of the horn in the hands of the receiver.

In this city of forty thousand, if but eighteen miles had been built and bonded for $540,000, with an annual interest of $27,000 we could have shown at least $600 surplus, and with the modern methods of increasing traffic, this surplus could undoubtedly be increased to pay the stockholders a fair rate of interest.

If for obvious reasons it becomes necessary to extend the track beyond the populated limits, care should be taken to focus the promoting energy upon one line, and to extend no other lines until the one so extended has been so populated that that line shall be self-supporting, as with the extension of several lines in different parts of the city, the various interests become separated and each line so extended only receives a very widely scattered population, that must take years to promote into a paying territory.

Precaution must be observed in running out suburban lines for park and pleasure resorts, as we can only count on three months of pleasure travel, and a line built for pleasure travel only is apt to prove a problem with an unknown quantity. On the other hand, all parks and pleasure resorts introduced along existing lines, even though built at a considerable expense, if properly managed, will prove a booster to the net receipts of the lines favored.

In locating pleasure resorts, if possible, they should be placed on lines connecting two towns, as then you promote traffic in both directions, and are not to a large extent paying for an empty mileage in one direction; and you are also promoting traffic to the thinly populated section of your road. To clinch my argument, I will quote from an editorial in the *Street Railway Journal*: "The total street railway mileage of the United States is approximately six per cent. of the steam railroad mileage. About six per cent. only of this mileage is at present in the hands of receivers, as against about 25 per cent. of the steam railroad mileage. The gross earnings of all American street railway properties are probably slightly less than 15 per cent. of the combined freight and passenger earnings, but are nearly 50 per cent. of the passenger earnings alone of the steam railroad properties, while the net income applicable to dividends on capital stock is hardly less than 35 per cent. of the steam railway income. These results are surprising, indeed. That 14,000 miles of street-railway track should be able to earn half as much gross on passenger traffic, and one-third as much net (for dividends) on combined passenger and freight traffic, as is earned on 234,000 miles of steam railroad track; this is certainly a remarkable showing and one which points to a very reasonable cause for a capitalization per mile of track larger for the street railway than for the steam railway properties."

When we have carefully considered the subject of this paper, "Are we laying too many miles of track to reach a few people?" the results of a comparison between the steam and street railroads are not so surprising, as there is no doubt if the cities could all be moved within a few miles of one another along the lines of the steam railroads, their passenger receipts would show an immense increase, and a corresponding decrease in operating expense.

Even though the steam road charges three cents a mile, and the street railway often gets less than one cent a mile, we find that the receivers' hands and pockets are being filled by the steam roads, because even at three cents per mile, enough passengers must be carried to support a lengthy mileage through the unpopulated country.

1. A paper read before the Street Railway Association of the State of New York at Albany.

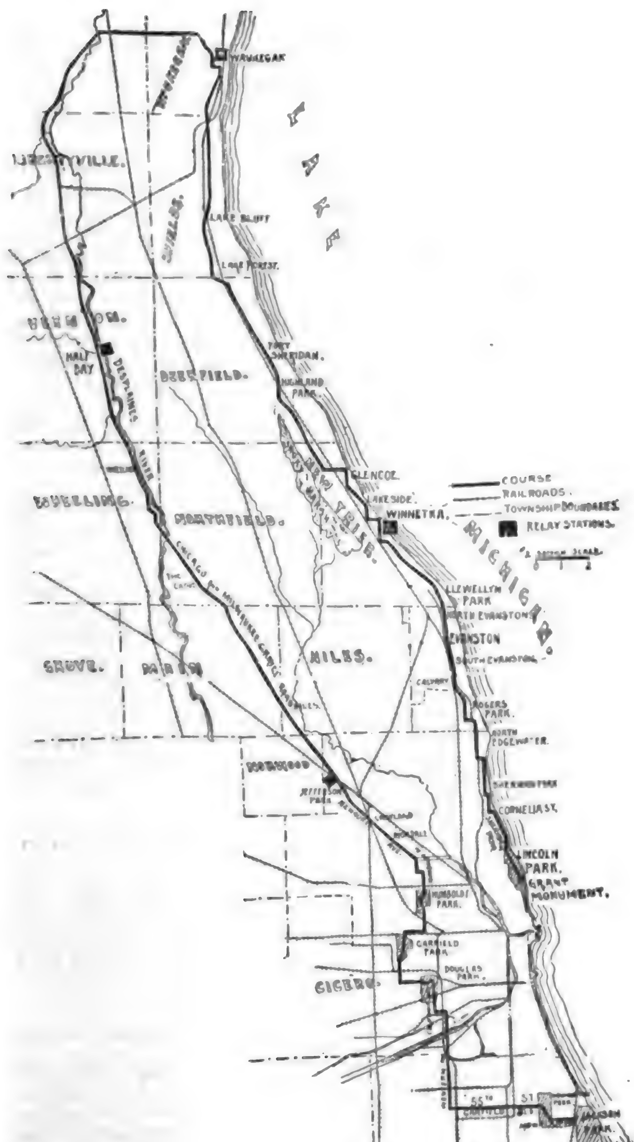
MORE ELECTRICITY FOR THE NEW YORK, NEW HAVEN & HARTFORD.

The twenty-fourth annual report of the Consolidated Railroad is very interesting to electricians. The announcement is made that the road has secured a controlling interest in the Stamford Street Railroad Company, and proposes to develop that property in close relationship to the New York, New Haven and Hartford Railroad Company. Of the electrical equipment of the Nantasket Beach Road, the report says: "The experiment has demonstrated that power generated in a stationary plant and transmitted by electrical agency can be successfully used in the operation of a standard railroad. The current expenses for fuel indicate that this result is economically obtained. Power thus transmitted is capable of indefinite subdivision, and is, therefore, most available for frequent car service. The commercial result depends only on the durability of electrical equipment. The use of the existing power station will be extended presently, and it is probable that

electricity will be promptly adopted by the company at other points on its lines. With a road free from grade crossings, it is not too much to expect its ultimate application wherever the business justifies a frequent train service, and it is to be hoped without the use of an overhead trolley."

THE CHICAGO MOTOCYCLE CONTEST.

Arrangements have now been fully completed for the motocycle contest organized by the Chicago *Times-Herald*, which will take place on Nov. 2. The route has been definitely decided on and is illustrated in the accompanying map. The carriages will start from Jackson Park and go by means of the Milwaukee gravel road to Waukegan, returning by the road skirting the Lake shore with the finish at the Grant Monument in Lincoln



THE ROUTE OF THE CHICAGO MOTOCYCLE CONTEST.

Park. Nearly one hundred entries have been made up to date, and we give the names of the contestants below:

B. J. Arnold, 1541 Marquette Building, Chicago; A. B. Andrews, Center Point, Iowa; D. J. Ames, Owatanna, Minn.; A. C. Ames, 8680 Essex avenue, South Chicago; Bradley, Wheeler & Co., Kansas City, Mo.; E. Wirt Bowman, Evanston, Ill., four types of vehicles; C. H. Barrows, Willimantic, Conn., two vehicles; N. Barcus, 550 East Tawes street, Columbus, Ohio; W. H. Brown, Postoffice Box 108, Cleveland, Ohio; C. W. Beck, 2572 Lakewood avenue, Chicago; Chicago Fireproof Covering Co.; H. C. Todd, 48 Franklin street, Chicago; Chicago Carriage Motor Co.; C. O. Hansen, 842 Center street, Chicago; Cook & Gowdey, 6824 Madison avenue, Chicago; Oliver F. Conklin, Dayton, Ohio; H. H. Carpenter, 1087 Monadnock Building, Chicago; E. D. Cross, M. D., 8149 Indiana avenue, Chicago; Cronholm & Stenwall, 819 Le Moyne street, Chicago; Henry W. Clapp, Sheridan avenue, Springfield, Mass.; Davis Gasoline Engine Company, Waterloo, Iowa; M. H. Daley, Charles City, Iowa; Thomas M. De Freet, Adjutant General's office, Indianapolis; Charles E. Duryea, Springfield, Mass, or Peoria, Ill., two and possibly three vehicles; De la Vergne Refrigerating Machine Company—George Redwood, Foot of East 188th street, New York, four machines; G. Elrick, 904 Irving street, Joliet, Ill.; R. W. Elston, Charlevoix, Mich.; J. C. W. Feerrar, Lock Haven, Pa.; T. R. Gawley, Aurora, Neb.; R. W. Guilford, Auburn, Ind.; J. A. Hildebrand, 808 State street, Chicago; Hartley Power Supply Company, 21 Monadnock Building, Chicago; Max Hertel, 454 Lincoln avenue, Chicago; Hill & Cummings, 282 South Clinton street, Chicago; John W. Hall & Sons, per Harry Lee, Jacksonville, Ill.; Indiana Natural Gas Company - Haynes & Apperson, 28 Buckeye street, Kokomo, Ind.; J. D. Hagaman, 52 Riverside avenue, Adrian, Mich.; Lyman S. Holmes, Gloversville, N. Y.; Frank W. Haviland, 210 West 123d street, N. Y.; Milton E. Holton, 375 Dayton street, Chicago; W. J. H. Kappe, Quincy, Ill.; George W. Lewis, 32 Willis court, Chicago; R. E. Lasher, 2782 South Third street, St. Louis, Mo.; Leppo Brothers, Belleville, Ohio; Laporte Carriage Company, Laporte, Ind.; V. L. D. Lowery, Eaton, Ill.; P. E. M'Donald and W. F. Brennan, Kedzie avenue and Thirty-fifth street, Chicago; Walter Macleod, 187 East Seventy-third street, New York; J. U. Moelin, 1810 Fond du Lac avenue, Milwaukee; Edwin Meredith, Batavia, Ill.; M. B. Mills, 125 La Salle street, Chicago; Morris & Salom, 926 Drexel Building, Philadelphia, two electric motocycles; A. W. M'Arthur, Rockford, Ill.; H. Mueller, Decatur, Ill.; Mills & Searles, Chicago; The Maguire Power Generating Co., 709 Masonic Temple, Chicago; Fred. G. Norton, 486 Julian street, Waukegan, Ill.; John E. Praul, 262 North Broad street, Philadelphia; Pierce Engine Company, Racine, Wis.; W. J. Parks (Ellingen & Parks), La Salle, Ill.; William Paterson, 802 South Morgan street, Chicago; Pierce-Crouch Engine Company, New Brighton, Pa.; W. A. Pierce, Sistersville, W. Va.; S. W. Roberts, 80 Dearborn street, Chicago; Riel Import Co. (Benz Motor), 51 Dearborn street, Chicago, two motocycles; C. G. Reid (Columbia Perambulator Co.), 98 Market street, Chicago; G. W. Robertson, Mount Vernon, Ind.; W. J. Radford, 50 Union street, Oshkosh, Wis.; Strong & Gibbons, 181 West Madison street, Chicago; Ira D. Smith, 6004 Ellsworth avenue, Pittsburg, Pa.; Stone & Maynard, Avonia, Pa.; Otis E. Smith, Hartford, Conn., Box 38; Joseph Shaver, Walnut and Nineteenth streets, Milwaukee; Sturges Electric Motocycle, 1187 Marquette Building, Chicago; C. J. Schoening, Oak Park, Ill.; Sintz Gas Engine Co, Grand Rapids, Mich.; A. J. Schindler, 441 West Twenty-first street, Chicago; John Teepleton, 1616 Masonic Temple, Chicago; Thomas Kane Co., 137 Wabash avenue, Chicago, this firm enters six motocycles; Elwood E. Taylor, Fitchburg, Mass.; Frank Vanall, 1031 Gurney street, Vincennes, Ind.; U. J. Verret, 818 Cherry street, Pine Bluff, Ark.; G. C. Woolverton, 827 Washington street, Buffalo, N. Y.; Wayne Sulkeyette and Road Cart Co., Decatur, Ill.; Vernon H. Wilkins, 2249 Ridge avenue, Evanston, Ill.

ELECTRIC LOCOMOTIVE FOR THE ST. CLAIR TUNNEL.

The Grand Trunk Railroad is about to adopt the electric locomotive for the service through the tunnel under the Detroit River at Port Huron. The tunnel is a mile and one eight long, and the grade at both ends reaches 105 feet to the mile. Specially constructed locomotives, weighing ninety-five tons and having eight drivers, are used to haul the trains through. The reason of the proposed abandonment of these engines is the effect of the steam upon the tunnel structure. The cut through the rock is lined with steel casing, at the back of which is a filling composed of a peculiar kind of asphalt. The escaping steam and the excessive heat exercise such an effect on this backing that it is rapidly deteriorating, and in other ways they are injuring the tunnel structure.

AFFECTING THE C. B. & Q.

The Burlington has never had any competition for its Chicago suburban business. While its service has been fair, its commutation rates have been, and still are, it is asserted, unreasonably high. The electric line which is to compete for the Burlington's suburban business has every reason to expect big returns on its investment. It promises to make the run by transfer between Berwyn and State and Madison streets in 40 minutes, without dust, smoke, or noise. The one-way fare will be 10 cents; lower than the lowest commutation rate of the Burlington, its cars will run often, and a late night service is promised. Altogether the residents of the Chicago southwestern suburbs are jubilant over the prospect of competition for the Burlington Road and believe that the value of real estate will advance in consequence.

NIAGARA FALLS POWER ON A CANADIAN ROAD.

A special dispatch of Sept. 18 from Montreal says: A contract has been entered into between the Hamilton Electric Radial Railway Company and the Niagara Falls Power Company which assures the construction of an electric railway between Hamilton and the Canadian falls.

HOW SHALL WE HEAT CARS?—III.

BY J. F. MC ELROY.

(Concluded.)

The next point in regard to electric heating is the regulation of temperature. As the temperature of the outside air during the heating season will vary from 50 degrees to 15 below zero, I consider it important that the electric heating apparatus be so constructed that the amount of heat given to the car be varied so as to meet the demands of the variable weather. This is necessary for two reasons. First, it is necessary in order to maintain a comfortable temperature in the cars with variable conditions in the weather, and second, it is important in order that the consumption of current shall be adjusted to the actual demands. Undoubtedly a great saving in the use of current is brought about by the use of apparatus that is provided with means for proper regulation. This is illustrated by the diagram, Fig. 3, which shows the amount of heat necessary to heat a car at different temperatures. (The author then referred to and briefly described the 5-point switch used for regulating the 6-heater car equipment and the 3-point switch used in the 4-heater equipment.)

As to the cost of heating cars by electricity, it is evident that it is determined by the cost and quantity of current consumed. If the number of ampere hours on a 500 volt circuit can be once determined and the cost of an ampere hour on the same circuit is known, the cost of running electric heaters can be readily ascertained. The question of cost, however, is not easily determined, as it still remains an open question as to just what items should be charged to electric heating. I am inclined to think that it would be but fair for a company considering the advisability of introducing electric heaters in their cars, to consider, not the total proportionate cost of current consumed, but rather the additional cost of generating the current to supply the electric heaters. In other words, it would not seem just to charge to electric heaters such power house expenses as would continue the same provided electric heaters were not introduced; but instead, to charge only the cost of the additional current. These costs have been carefully determined, based upon the cost of producing power by different types of engines as contained in the paper of Charles E. Emery, Ph. D., which is printed in the proceedings of the American Institute of Electrical Engineers for March, 1893. These figures of Mr. Emery's appeared in print some years and have been carefully revised to agree with results obtained in the most modern types of engines. The costs are based upon units of 500 horse power and so far as the figures by Mr. Emery are concerned, give the cost of horse power at the engine wheel or jack shaft. I have then allowed an efficiency of 90 per cent. in the generators and assume an efficiency in the distributing system of 93 per cent, making a combined efficiency of generators and lines of about 83 per cent.

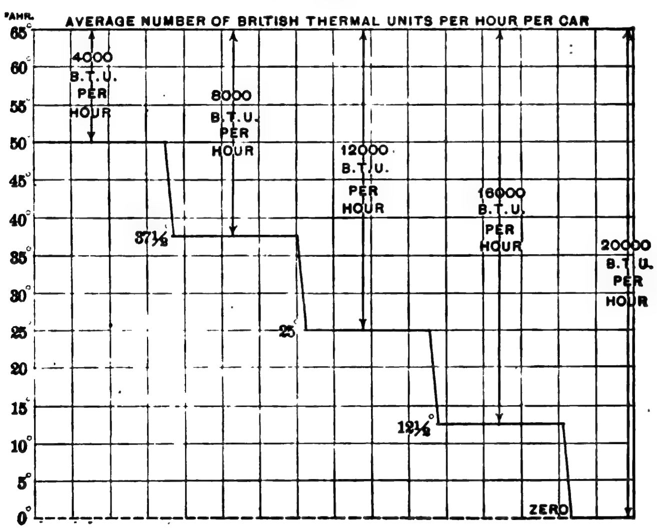


FIG. 3.

From the reports which we have recently received from street railways in this State, I find that the average efficiency of the lines of the companies reporting was .923. This so closely confirms my previous estimate of .93 that the figures based on my former estimate are still retained. Corrections can be made upon the figures contained in the table to fit any given case, as it is found that the efficiency of the lines may be greater or less than 93 per cent.

The cost of operating electric heaters will depend upon the kind of engine employed and the cost of coal. For example, if coal costs $2 a ton of 2,000 pounds, and if the average consumption of current in cold weather is 7 amperes, and if we take a compound low speed condensing as the average type of engine in point of economy in consumption of fuel, we will find that 7 amperes for one hour will cost 1.17 cents.

From the reports which we have received, I find the average length of time a car is in service per day in the winter time to be 15 hours. The cost of operating electric heaters with the average consumption of current in cold weather would, therefore, be 15 times 1.17 cents, which equals 17.55 cents for 15 hours. This cost does not allow for any depreciation in heaters as the three years of service of these heaters does not appear to have any effect upon the life of the conductors, and not a single coil in any heater has ever been renewed in this length of time. So far as examinations of the coils that have seen three years of service can determine, absolutely no oxidation has been produced upon the wires. Some allowance, however, should be made for repairs when the amount of necessary repairs can be ascertained.

As to the cost, now, of heating by stoves, I will say that I have a number of reports from different railroads in this State using stoves. The list of questions which I submitted was designed to bring out as full information as possible in regard to the operation of cars equipped with these stoves. Several roads furnished me with reports, and where quantities are mentioned the figures given are the average of the quantities stated in these reports, as follows:

Taking the average made in the answers referred to, I find that 83 pounds of coal were used per car per day, costing $4.55 per ton of 2,000 pounds. This coal costs 7½ cents per day. The average cost of repairs per car is ½ cent per day. The average cost of dumping fires, removing coal and ashes before car is run out of barn, and coaling up and kindling fire in the morning, including the cost of kindling used and that part of cleaning cars chargeable to stoves is 10 cents per day. The average cost per day of other expenses chargeable to stoves not included in above, such as cost of removing stoves for the summer, installing of the stove in the Fall, repairing of head linings, repainting, etc., averages 1¼ cents per day. Without adding anything to the cost of the stove for the space for one person occupied by the stove, I find that the total of the items so far aggregate 19¼ cents per car per day. It has already been stated that the extra cost of current based upon the cost of power necessary to heat a car with 7 amperes of current on a 500 volt circuit aggregates 17.55 cents per car per day. This amount will be modified as different types of engines are used; for the type of engine generally used it is correct.

Another question of greater importance, however, than the cost of the mere heating by electricity or stoves, is the effect which electric heating has in inducing travel upon street car lines. It is, however, a difficult thing to determine in figures exactly what increase of travel takes place on account of having cars properly heated at all times and that heat being properly distributed through the car. I am not at this point prepared to give any figures or estimates based upon this point. I, however, believe that it is worthy of the consideration of managers of street railways in the matter of securing patronage for their lines.

TAKING DOWN TROLLEY POLES IN WASHINGTON, D. C.

The trolley road of the Eckington & Soldiers' Home Railway was the first to be built in Washington, but under recent orders of the District Commissioners it is now being dismantled on New York avenue between Seventh street and the City Boundary. What is to replace it, is not yet announced. Horse cars are meantime plying again, much to the disgust of the people.

NEW TROLLEY ROAD IN MADISON COUNTY, NEW YORK.

The Chittenango and White Sulphur Springs Railway Company has been incorporated with a capital of $150,000, to construct and operate a street surface road about five and seven-eighths miles long in Madison County. The termini are, northerly, the New York Central and Hudson River Railroad tracks at Chittenango Station, and southerly, the southerly boundary line of the town of Sullivan, in Madison County. The principal office will be in New York City. The directors are: Charles F. Pennock, George Walrath, George C. Clark, Walter H. Stewart, Luke McHenry, William H. Young of Chittenango; Walter J. Roberts of Franklin, N. J.; Henry C. Blackman of Brooklyn; William Sutphen, J. F. Sprain, J. B. Dickinson, Austin J. Roberts, Henry E. Parson, K. J. Matheson and J. F. Clark of New York City.

UTILIZING GUNTER'S GUSHER.

A syndicate proposes to build an electric railway from Bagnell to Lebanon, by way of Gunter's Spring, in Camden county. Jefferson City will thus be accessible to the southern part of the state. The electricity will be generated by water power at the spring, where a mammoth plant will be erected. The spring is said to be the most wonderful in the world. The water bursts out of the earth at the foot of a crag 200 feet in height, in a stream 60 feet wide and 5 feet deep, with a current so swift that the power is incalculable.—*Springfield, Mo., Republican.*

RUNNING THROUGH FRESHETS AT MIDDLETOWN, CONN.

CAR motors are occasionally put to severe usage, and as adversity is said to prove the worth of friends, so hard usage tests the value of motors. Our illustration, taken from a snap-shot photograph, shows what a trolley may at times encounter. During last Spring the freshets invaded Middletown, Conn., and for some days the water stood from twelve to eighteen inches on certain streets through which the line of the Middletown Street Railway runs. Supt. Goss says of the behavior of the motors: "The photograph was taken last April by a party who was

RUNNING THROUGH FRESHETS AT MIDDLETOWN, CONN.

impressed with the novelty of a street car running through so much water (some over a foot). Two of our lines run over this piece of track, which is our main track, and all cars made their regular schedule time for two days through this water, through the rise and fall of the freshet. Through all this and hauling three and four loaded trailers, taking care of last winter's snow, etc., we have had nothing burn out, not even a fuse strip. Our cars are all equipped with G. E. 800 motors and K2 controllers, and are giving us good service."

LETTERS TO THE EDITOR.

CLOSED CONDUIT RAILWAYS PREFERABLE TO OPEN ONES.

Referring to your editorial on "Conduit Railway Optimism," will you kindly permit a few words from one who has been actively at work for the past three years on the problem of finding a commercial substitute for the overhead trolley of which he, in conjunction with Lieut. Frank J. Sprague, was the pioneer. That method of current supply was adopted by us, because it was cheap and simple, and thus afforded the least handicap of the real contest which was as between electricity and horses.

It is now idle to say that in that contest, electricity has won. 20,000 cars running by electricity and 200,000 dumb brutes released from slavery, best attest the judgement of Mr. Sprague and myself.

In parenthesis, we are not posing as ambitious Bergs but we nevertheless claim to have our account accredited with a greater achievement in the emancipation of the poor brute than that honorable and renowned soul was able to secure in a life time devoted to the single purpose. Moreover, to continue the parenthesis, we are not yet done with the good work; we shall yet by way of the horseless carriage relegate him to the sole realm of man's pleasure, and consequent plenty as to oats and care.

But to return to our mutton. Having demonstrated the all-sufficiency of the electric agency as a motive power, we went back over the line in a retrospective way and planned a new campaign. Sprague conceived the notion that there was a great waste of that God-given element, water, in our urban life and he would emancipate it as he did the horse. Whereupon he substituted electricity for hydraulics, in the work of elevating man, and as you are aware, has in this great work scored his second brilliant success. I took the humane and æsthetic side of the problem of Electric Railways, and decided to devote myself to the work of ridding our streets of that obnoxious factor of our own creation, viz.: the obstructive and unsightly overhead trolley. In considering this problem I applied the practical side of my business character and decided that success could only be achieved through the medium of a method which would not involve a bankrupting investment. I therefore, analyzed the problem in this way:

Electricity being an imponderable force may be summoned through a solid as well as through an aperture, and as water is the natural foe of electricity, it was not scientific or business like to place the electrical conductors in a sewer and then expend hundreds of thousands of dollars to secure drainage. The natural sequence of this sort of reasoning was the hermetically sealing of the electric force and commanding it at will, through such seal, as required by the moving car. This idea was not new (few ideas ever are) but it had not been worked out and reduced to practice mainly, I think, because it was looked upon as finical and not in harmony with good engineering practice. In this I could not concur, as my training in telegraphy taught me that about the most reliable thing in the physical world was an electro-magnet and therefore that I had in it an agent which would, beneath the earth's surface, as surely and reliably do my bidding as any that could be employed in the open. In this work I associated with me Mr. Robert Lundell, and together we have evolved a system which we now present, in answer to the superficial criticism of *The Electrical World*, and in support of your views as expressed in the article under consideration.

Coincident with the great ado the General Electric and The Metropolitan Traction Company of this city are making over the practical success of their $150,000 per mile open conduit system, Friend Westinghouse is filling the land with pæans of praise of a new and great discovery, which he has made and is about to proffer in solution of the problem. Expressed in a nutshell, this discovery is, that my judgment is sound, that the closed conduit system, as it is generally called, is the correct principle, but he would have the Westinghouse homestead named as its birth-place, instead of the Johnson-Lundell cradle in which it was really born. Unfortunately for this little scheme of appropriation, I am still in evidence. First, with the patents which cover the system broadly, and second, with a record of nearly two years' actual practical operation in the heart of the City of New York, and therefore in the eye of the world.

Moreover, the real evolution of the system has taken place under my fostering care, and our stage of development is many moons in advance of that of my Pittsburgh friend. These facts of rivalry in our line are, however, only alluded to by way of emphasizing the soundness of the new principle. As to who is its real proprietor is not material to the present issue. What is, and what I want to promulgate and challenge investigation about, is as follows:

1st. The overhead trolley is doomed in cities and towns.

2d. The open conduit system would bankrupt 99 per cent. of the street railways, and is therefore not a commercial success.

3rd: The "closed conduit" system is an absolute success and can be installed for less than 25 per cent. of the cost of the open conduit method.

4th: That by means of the closed conduit system, the art which has hitherto demanded a lower voltage when underground than when overhead, can now be reversed, and a higher voltage be employed underground than overhead, thus reducing investment in copper, an item of such importance that in the case of any very extended system of roads, the saving in copper alone would suffice to pay for the other parts of the system. In this case the cost of the closed system would be practically as nothing is to $150,000 per mile for the open conduit system.

To anyone seriously seeking for information on this subject, an invitation to call and examine is cordially extended. If they shall, upon investigation, decide that they have been inveigled into a fool's errand, I will gladly pay their expenses.

EDWARD H. JOHNSON.

NEW YORK CITY, Oct. 3, 1895.

ACME BATTERY RAILWAY FIGURES.

IN the Oct. 2nd issue of THE ELECTRICAL ENGINEER I note that those exploiting the "Acme Storage Battery" have made use of figures contained in my article (published Sept. 18th in THE ELECTRICAL ENGINEER) in such a way as to make it appear that accumulator traction with "Acme" batteries will compare favorably with the trolley system so far as operating expenses are are concerned.

If you will kindly permit me the courtesy of your columns I should like to say that my figures were not predicated of storage batteries in general, but simply of a special type of battery which is in use for traction purposes in Paris, France. As a matter of fact, many different types of accumulators that have been used in this sphere of work have been pronounced failures. Obviously the principle of utilizing actual working figures obtained by one type of battery as the basis for a statement of what a different type will do in the same kind of work, is altogether wrong. Every battery that is to be exploited will have to be independently tested for a considerable period of time; and only the actual statistics derived from the observation of its performance during this period can furnish the basis of an estimate of what may be expected from it in general traction undertakings.

MAURICE BARNETT.

PHILADELPHIA, PA., Oct. 4, 1895.

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CONTENTS.

LOST: FIFTEEN MILLION PASSENGERS.

ON several occasions within the past few years it has been rumored that the Manhattan Elevated Railway Co., in New York, were "looking up" electric traction with a view to the adoption of the system on their roads; and only recently Gen'l Manager Hain, with Mr. Howard Gould, was on a trip of inspection through the large electrical manufactories of the country, gleaning information on the subject. Perhaps it may have been with a purely philanthropic desire to furnish the patrons of the road with a quicker, better and more comfortable method of transit that this trip was undertaken, but in looking over the Annual Reports submitted by the New York city railways to the Railroad Commissioners we may find probably the true significance of the interest taken by the Elevated Railway management in electricity. These Reports for the twelve months ending June 30th show that the number of passengers that the Manhattan Co. carried on its lines during the period mentioned was 187,614,985 as against 202,751,532 carried during the previous year; that is, a *decrease* of 15,136,547. In contrast to this marked decline, we note the corresponding figures reported by the Metropolitan Traction Company, which were respectively 129,486,890 and 112,342,899, an increase of 17,143,991; while the Third Avenue Surface (Cable) rose from 35,900,000 to 49,500,000, an increase of 13,600,000. The Metropolitan system includes the Broadway and Ninth Avenue Cable roads and the electric conduit road running up Lenox Avenue, recently put in successful operation.

If the figures above given are correctly reported by the Companies, they indicate unmistakably that the elevated roads as they are now operated in New York, cannot hold their own with surface traction for the average distance of travel within New York City, the slight increase in speed now offered by the elevated roads not compensating for the discomforts attending their use as at present operated The question naturally arises, what would it cost to regain the lost traffic and to increase the income of the road now obviously retrograding in its earning capacity? It has been estimated that it will cost five million dollars to convert the New York elevated system from steam to electricity. This amount, issued in bonds at 6 per cent., would require, irrespective of sinking fund, $300,000 to carry in interest charges (assuming a 6 per cent. bond issue, a figure which would probably have to be taken in view of the previous obligations already resting upon the road). Fifteen million passengers regained would mean an increased income of $750,000, so that, at the figures above assumed, the road would still be $450,000 to the good on its investment in electrical equipment. No one who has given any attention at all to the subject can doubt that with cars electrically propelled, properly lighted and heated, and with longer trains, or more frequent short ones, which the electrical method at once makes feasible, the income of the roads may be not only brought up to its former figures, but increased beyond the maximum which they have hitherto been able to show. If added to the other improvements, a system of electrical elevators be installed at all stations, taking power from the railway circuits, many thousands more would be daily induced to ride than we now know to be the case. Indeed,

viewing the subject from whatever standpoint, the conclusion forces itself upon one that electricity must be adopted on the elevated roads in New York not only in response to objections against the steam locomotives, but as a means of actual self-preservation on the part of the Company.

JAPANESE CABLE LAYING.

There seems to be little that the plucky Japanese cannot take hold of and handle successfully, but we confess our surprise at finding them ready to undertake cable laying. It is stated that they have bought 800 knots of submarine cable to connect Japan with Formosa, and are going to lay it themselves. The next thing they do will be to manufacture the cable itself, and supply the whole Eastern world. When the time comes for connecting Asia with America by direct cable, the alert and energetic Japanese may want to do some more cable work, and, judging from present indications, they are far more likely to be "in it" than Americans are. Somehow, our cable manufacturers, admirable as are their products, never get down to deep sea work.

THE CONVENTION IN CANADA.

It is some five years since the National Electric Light Association visited Canada, and now another electrical body, the American Street Railway Association, is also to enjoy the generous hospitality of Montreal. If any of our readers are hesitating as to indulgence in this trip, we advise them to take it, as one from which they will derive much benefit and real pleasure. Aside from the beauties of Canadian climate and scenery at this season of the year, there are many points of engineering interest; and it will surprise many visitors to discover how good the average work is. The articles we have published descriptive of electric railway work in Montreal, Toronto, Niagara Falls, St. Catharines, Ottawa and other cities exemplify not only an early adoption of electricity but a solidity that is quite meritorious. Altogether the convention of 1895 should be availed of, especially by those who have not been able so far to get away this year for "foreign travel."

PROGRESS IN ELECTRIC POWER TRANSMISSION.

As week by week we chronicle the inauguration of new power transmission plants, it is not difficult to discern the place which electric power will occupy in the future. Enough has been shown in the brief period of ten years to demonstrate that, only in rare and special cases, can any other form of power compete with electricity on an even basis. While this is conceded, the question of the best and most economical methods to be employed electrically are still among the matters which will bear discussion. Just at present the three-phase system seems to have the greatest number of advocates for long distance work armed with able arguments as to copper economy and other valuable attributes of this method, and if the number and size of the plants erected on this system be considered they would certainly appear to have so far the better of the argument. The latest work carried out on this system, that at Portland, Ore., which we describe and illustrate very fully in this issue, is another striking example of its flexibility. But we must not lose sight of the original polyphase system, the two-phase, which is already doing good work and which has still to be given a crucial test on a large scale at Niagara. When the latter plant has been in full operation for a few years one will be better able to judge of the relative merits as between two and three phases or to apply either one to the cases best suited to it.

THE ELECTRIC LIGHTING SEASON.

Summer has waned, Fall is here, and the electric lighting season begins again. It will be a brighter season by far than that of 1894-5, for times are slowly improving and the consumer is less willing to sit in darkness and lament the absence of patrons, or to go to bed early in order to economize with light and fuel in his home. We hear from several central station managers that arc lights for street exteriors are in excellent demand and that the racks in the store room are being actively depleted. The number of parallel arcs is moreover, we are informed, rapidly growing for interior work, and as a matter of fact, in measuring light for light, at cost for cost, the parallel arc proves a far more effective competitor with the Welsbach burner than the ordinary incandescent. Of the Welsbach, we have not heard much during the hot summer months, when it is literally insupportable; but with the return of cold weather, its value as a partial stove may give it renewed popularity. Meantime, our central station friends may push the incandescent boldly, for there is no other light on the market that is half so good in all around qualities.

THE NANTASKET BEACH TEST.

The Nantasket Beach trolley service from Boston has been so successful that the statistics for the summer season just closed show the traffic on the branch to have increased 300 per cent. over that of the steam service of 1894. Such an increase would of itself go a long way in paying for the expenses of the experiment; but it is believed that even these figures will be excelled in 1896. The trolley has proved itself a delightful means of travel,—quick, smooth, quiet and smokeless—from the city to the shore; and the people want more of it. The opinion of the Consolidated Railroad officials is not less favorable and enthusiastic, as will be seen from the annual report quoted elsewhere. So much then has been achieved. It is not bad work for one short season. It does not settle everything, but it is pretty conclusive in showing that for short, frequent, heavy passenger travel, electricity is better than steam on such roads. A few of us ventured to predict this.

ANOTHER FLY-WHEEL "ACCIDENT."

The bursting of a fly-wheel and partial wreck of the Hudson Electric Light Co.'s station at Hoboken, N. J., points a lesson which may well be impressed upon those in charge of central stations. It seems that a short circuit on the line had blown the fuses, and during their replacement the engineer had slowed down the speed of the engine *by raising and holding up the governor*. The new fuses had no sooner been replaced, however, when they blew again, and the engineer becoming "rattled," in order to slow the engine down again, held the governor *down*. The result was natural, and the engine raced until the fly-wheel burst. The unfortunate engineer paid with his life the penalty of his carelessness. But it seems hardly credible that anyone should take such a means of reducing an engine's speed, instead of shutting off the steam at the valve. It is to the credit of Chief Engineer Bonta that, with the accident occuring at 4 in the morning, by 6 o'clock the gaping holes in the brick walls had been nearly closed, the roof entirely replaced and covered, the steam connections re-established, and current turned on the lines again.

TELEPHONY.

SOME LESSONS IN TELEPHONY.[1]

BY A. R. BENNETT.

Given two nations, equal or nearly so in natural resources and in the talents and industry of their inhabitants, that one will succeed the better in commerce which possesses and most extended and cheapest facilities for transport the general intercommunication. It has recently been demonstrated that the United Kingdom is deficient in at least two of these essentials—railways in their branch or feeder form, and telephones, which are the natural feeders of the telegraphs. Why this is so may best be discovered by ascertaining by what means, technical or economical, those nations which have most conspicuously outstripped us have attained their superiority. For the purposes of this Paper, in which is considered the telephonic branch of the question, the countries of Europe have been divided into three groups: (1) well telephoned; (2) indifferently telephoned; (3) badly telephoned.

The accompanying table gives the leading characteristics of the management of each country.

The questions naturally arise "To what causes are such vast superiority of the results presented by the Scandinavian local companies and co-operative societies. Wherever management is centralized, uniformity is aimed at as a means to economy and of saving trouble, and what appears good in the capital is apt to be imposed on every other town.

In the countries of Group I., special attention is given to small town and rural development. In Switzerland a village council, commune, or other local authority may establish and manage a telephone station in one of its own buildings, and work it with its own employés, simply paying to the State the ordinary subscription of £4. 16s. for the first, £4 for the second, and £3. 4s. for the third and subsequent years, for the privilege of a junction with the general telephone system of the country. Such stations, of which there are 129 in Switzerland, are available for the dispatch and receipt of written telegrams as well as of telephone messages. The local authority is authorized to collect a small surcharge on the ordinary tariff to cover expenses incurred for wages, office, and the annual payment to the State. In Luxemburg a similar system prevails, and is taken advantage of by 34 local authorities. The annual payment to the State for the connection of the municipal station to the general system of the country is uniformly £4 per annum. France has adopted a similar system, but with a much higher scale of charges and with restrictions which appear irksome to the local authorities, since in

Order of Merit.	Country.	Population.	Number of Exchange Telephones.	Number of Persons to Each Exchange Telephone.	Characteristics of Management.
	GROUP I.				
1	Norway	2,000,917	13,948	144	Very low rates. Local management of exchanges. Good rural intercourse. No competition.
2	Sweden	4,784,981	32,602	147	Very low rates. Local management of exchanges in part Good rural intercourse. Competition.
3	Luxemburg	211,088	1,315	160	Very low rates. Central management, but with delegated control in some cases to local authorities. Good rural intercourse. No competition.
4	Switzerland	3.000,000	17,422	172	Ditto ditto ditto.
5	Denmark	2,185,335	10.325	211	Very low rates. Local management of exchanges. Good rural intercourse. No competition.
6	Finland	2,412,135	7,351	328	Very low rates. Local management of exchanges. Good rural intercourse. Competition.
	GROUP II.				
7	Imperial German Post Office Territory.	41,796,966	93,131	449	Fair rates for urban subscribers in large towns; high rates in small towns. Highly centralized management. Bad rural intercourse. No competition.
8	Bavaria	5,594,982	12,400	451	Ditto ditto ditto.
9	Wurtemburg	2,036,522	4,430	459	Low rates for urban subscribers, but with regulations tending to restrict suburban and rural intercourse. Centralized management. No competition.
10	United Kingdom	37,880,764	59,569*	636	High rates, with regulations unfavorable to development outside towns. Local management in part. Practically no competition.
11	Holland	4,669,576	7,263	643	High rates in three chief towns; low rates elsewhere. Management chiefly centralized. Bad rural intercourse. No competition.
12	Belgium	6,136,444	8,757	700	High rates in large towns; low rates of recent origin in small towns. Centralized management. Indifferent rural intercourse. No competition.
	GROUP III.				
13	France	38,343,192	26,772	1,432	High rates; subscribers also pay capital cost of their installations, except in Paris and Lyons. Centralized management. Bad rural intercourse. No competition.
14	Spain	17,800,000	10,984	1,618	High rates in large towns. Recently introduced reduced tariff for smaller towns. Local management. Bad rural intercourse. No competition.
15	Austria	23,895,413	14,574	1,640	Fair rates, but subscribers pay capital cost of their installations. Centralized management. Bad rural intercourse. No competition.
16	Italy	30,535,848	12,067	2,530	High rates in large towns, except in Rome, where competition exists; low rates in Rome and in small towns, but under strict Government supervision. Bad rural intercourse. No competition except in Rome.
17	Hungary	17,463,473	5,563	3,139	High rates in towns; very low rates in villages, but combined with regulations which tend to restrict communication between towns, suburbs, and villages. Partly local management. No competition.
18	Portugal	5,000,000	1,483	3,371	Exchanges only in Lisbon and Oporto. Fair rates. No rural intercourse. No competition.
19	Russia	97,151,789	7,415	13,102	Highest rates in Europe in chief towns; high rates in smaller towns. Partly local management under Government rules. Bad rural intercourse. No competition.

* Company 58,367; Post Office, 1,202

differences in development to be ascribed?" and "Why is the United Kingdom, with its preponderating commercial importance and unparalleled spirit of enterprise, only tenth on the list, instead of first?" A study of the table supplies the answer. It shows that telephonic development is proportional to the prevalence of the following features: (1) Low rates; (2) local management; (3) facilities for rural intercourse; (4) competition. At least three of these are characteristic of each of the six countries which compose Group I. On the other hand, they are almost completely absent from Groups II. and III., the leading characteristics of which are (1) high rates, (2) centralized management, (3) neglect of small towns and rural districts, (4) absence of competition.

The operation of low rates and competition in the direction of development is easily understood, but that of local management is not so obvious. Its importance, however, is great. No two places are precisely alike in commercial, social or topographical features, and telephonic arrangements which suit one neighborhood admirably are not appreciated in another where other conditions call for other plans. To meet the wants of a locality fully, it is necessary that its character should be thoroughly understood at the headquarters of management, and this, when exchanges are numerous, is not attainable. On the other hand, a board or council of local men know the requirements of the community exactly; hence the

1. Abstract of a paper read before the British Association at Ipswich.

1894 only 10 municipal stations existed in the whole of France. In the Scandinavian countries and Finland, local management has had even freer play, with the highly satisfactory result disclosed in the table. The third town of Norway, Trondhjem (population 30,000), is worked by the municipality most successfully at very low rates.

On inquiring in what manner circumstances differ so gravely in the United Kingdom as to preclude the possibility of small towns and rural communities availing themselves of telephonic communication, it appears that, apart from the want of local control and competition, the inelasticity of the present system of tariffs, which was originally invented for towns, is much to blame. In towns distances are short, and subscribers, if the switchrooms are properly distributed, have seldom to pay more than the unit charge; but in country districts distances of several miles must often intervene between the subscriber and switchroom, and as the annual rental exacted increases rapidly with the distance the charges become piled up by the extra mileage beyond the means of the majority of the population. What is wanted is the application of the Austrian (which with some modifications has also been adopted in Luxemburg) system of tariffs, under which all subscribers, whatever their distance may be from the switchroom, are put on an equality as regards annual subscriptions, the only difference being made in the initial payment on joining the exchange, which varies with the length of line

required, the object being to reimburse the owners of the exchange system once for all for the additional cost of the extra mileage. In Austria the annual subscription is the same for any distance up to 15 kilometres (9½ miles). In Luxemburg the annual subscription, provided the distance of the subscriber from an existing route of wires is not greater than 1½ kilometres—which is seldom the case, so numerous are the lines—is always £3. 4s. per annum, which covers all charges for service and maintenance, and confers the right to talk all over the Grand Duchy, which measures 44 by 30 miles. If a subscriber is situated outside the free radius which surrounds every switchroom, he makes, on joining the exchange, an initial payment, designed to cover the cost of the line which intervenes between the free radius and his place. This is charged at the rate of £4 per kilometre only, and the payment may furthermore, if desired, be spread over five years. If located within the free radius, the subscription is simply £3. 4s. per annum without an initial payment. Comparisons are often instructive, and it will be interesting to examine the differences resulting from the application of this system and that which prevails at home.

The technical features of the Continental systems are, as a rule, best where the tariffs are lowest and the extension of communication greatest. The conditions laid down by the author in his paper on "The Telephoning of Great Cities," read at the Cardiff meeting of the British Association in 1891, as being necessary to a well-ordered exchange, are fulfilled more nearly in Sweden than elsewhere, especially by the General Telephone Company, which operates in Stockholm and a radius of 43½ miles around. Metallic circuits are universal; special attention is given to prompt switching, and Stockholm is divided into eight nearly equal divisions, each containing a switchroom. The prompt and economical addition of new subscribers is thus rendered easy. The speed achieved in switching is that stated in the paper to be practicable and proper in a good exchange—viz., 10 sec. The countries comprising Groups II. and III. are, with some exceptions, technically behind those of Group I. The reason lies on the surface. The conditions which prevail in Group I. bring about rapid extension; rapid extension involves the solution of

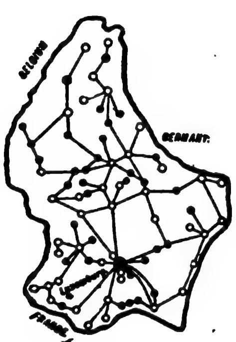


FIG. 1.

FIG. 2.

FIG. 1. TELEPHONIC MAP OF GRAND DUCHY OF LUXEMBURG. AREA, 998 SQ. MILES. POPULATION, 211,088.

FIG. 2. TELEPHONE MAP OF COUNTY OF DORSET, ENGLAND. AREA, 998 SQ. MILES. POPULATION, 194,517.

problems which do not present themselves while exchanges are in their infancy, and the solution of such problems evolve superior engineers.

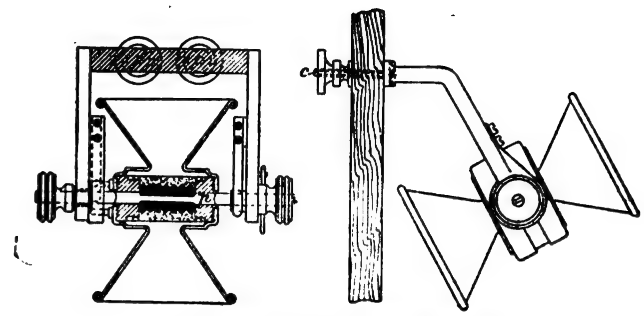
TELEPHONES IN AGRICULTURAL DISTRICTS.

In a paper on "The Development of the Telephone Service in Agricultural Districts," read by Major-Gen. Webber, before the British Association, it was sought to show that a great deal of the present condition of agricultural depression is due to the fact that your yokel cannot telephone to market or from village to village; and it was advocated that if he could get three minutes' talk for twopence, as it was attempted to show he might, he would soon become a happy and a prosperous yeoman. The speakers who took part in the debate were of a less sanguine condition of mind in regard to this matter; and they failed to see that what the telegraph had failed to do, the telephone was sure to accomplish, or to believe that the state of depression partially due to the former would be eradicated on the advent of the latter.

NORRISTOWN, PA.—The Norristown & Philadelphia Telephone and Telegraph Company has asked permission of the Town Council to construct a telephone line in Norristown, using the underground system of wires. The company offers in return for the franchise to pave all streets in which its conduits are laid, to supply free telephones for all borough offices and fire engine houses and pay to the borough annually 2½ per cent. of its net income.

THE NISSL DOUBLE MICROPHONE TRANSMITTER.

The Nissl double microphone, which is illustrated in section and in side view in the accompanying illustrations, has been designed with the object primarily of preventing the packing of the carbon granules, which has proved such an annoying inconvenience in the past in the majority of transmitters of this type. As will be seen, the two microphones are mounted back to back and one can be substituted for the other by turning the thumb-



THE NISSL DOUBLE MICROPHONE.

screw shown at the side, the motion being limited by a stop pin. By employing two transmitters they can be used alternately, and the motion of turning serves to shake up the granules, and to maintain them in the best working condition. It is also urged for this double microphone that the person telephoning is not compelled to use the same microphone which has immediately before been used by another person, a desirable thing, both from a hygienic and an æsthetic standpoint.—*Ztsch. f. Elektrot.*

TELEPHONE NOTES.

THE AMERICAN BELL TELEPHONE CO. has declared its regular quarterly dividend of 3 per cent.

DANBURY, CONN.—The underground telephone wire system in Danbury has been completed.

VANDERGRIFT, PA.—The Vandergrift Telephone Company has been incorporated. Capital, $1,000.

PAULDING, MISS.—B. W. Sharborough & Co. are constructing a telephone system.

SANDY SPRING, D. C.—The work on the telephone line between Sandy Spring and Laurel is being rapidly pushed.

LARAMIE, WYO.—The Bell Telephone company have made a reduction of 40 per cent. to subscribers to the Laramie exchange.

LIBERTY, N. Y.—The Delaware River Telephone Co. has been organized at Liberty, with a capital stock of $25,000.

THE CUSHMAN TELEPHONE AND SERVICE COMPANY, at Chicago, certified to a decrease in capital stock from $500,000 to $15,000 and to a change of name to the Universal Telephone Company.

YOUNGSTOWN, O.—Morgan T. James is at the head of a project to put in a new telephone system, the cost of instruments to be $18 a year on a five-year contract.

NEW ORLEANS, LA.—The Monroe Telephone Company has been compelled to order an additional switchboard and fifty additional telephones, to supply the demand.

KANSAS CITY, MO.—The Phœnix National Telephone Company of Indianapolis has solicited a franchise in Kansas City and means to put in a complete system there.

INDIANAPOLIS, IND.—William C. MacCurdy and David D. Smith have begun suit in the Superior Court on account and for the appointment of a receiver against the Phœnix National Telephone Company.

FREEPORT, ILL.—The management of the Freeport telephone exchange has in contemplation improvements of the service. It is proposed to place forty foot poles in the ground and at the top of these string large cables holding the wires.

MASSILLON, O.—The stockholders of the Farmer's Telephone Company have held their annual meeting. The following board of directors was elected. H. C. Brown, F. Z. Groff, Z. T. Baltzley, A. R. Hanna, L. J. Kurtz, R. A. Pinn, and J. H. Fisher.

SANDY HILL, N. Y.—At a recent meeting of the North Argyle Union Telephone Company these officers were elected: President, William C. Cuthbert; secretary and treasurer: James K. Henry. Directors: Hon. W. D. Stevenson, Rodney Van Womer and A. S. Cuthbert. Subscribers will have the use of the Fort Edward, Sandy Hill and Glens Falls switchboards of the Hudson River Telephone Company for five cents a switch.

RHINEBECK, N. Y.—The Hudson River Telephone company has just completed a telephone exchange at Rhinebeck.

CLYDE, N. Y.—The Wayne Telephone exchange has finished erecting poles from Clyde to Rose.

SALEM, ORE.—The telephone company has completed the construction of a telephone line to Morningside.

CARLISLE, PA., has again established a telephone system under a cheaper system.

ANSONIA, CONN.—There is to be a new telephone exchange established in this place.

RICHMOND, KY.—There will be a telephone line between Richmond and Berea.

MACON, MO., is to have telephone connection with Bevier and Brookfield.

TARKIO, MO.—A telephone line is being completed between Tarkio and Rock Port.

LOWELL, MASS.—The Lowell Telephone Exchange has been moved to its new quarters.

DETROIT, MICH.—The Harrison Telephone Co. has filed a formal acceptance of its ordinance.

LOGANSPORT, IND.—Poles for the new telephone exchange are being erected. There are 400 or 500 of them. It will be a metallic circuit. The exchange will be in working order by Oct. 1st.

ST. PAUL, MINN.—It looks as if the proposed telephone line from St. Paul and Minneapolis, via Albert Lea to La Crosse, is an assured thing.

CLYDE, N. Y.—The new telephone company operating in and about Clyde, claim to be making considerable headway. A cross county line—Savannah to Macedon—is proposed.

SPRINGFIELD, MASS.—The New England Telephone and Telegraph Company has been granted the right to place its wires underground.

SCHOOLCRAFT, MICH.—The manager of the Southern Michigan Telephone company has asked the village council for a franchise. It will probably be granted.

WACO, TEX.—The telephone company has completely rebuilt the system in Waco and is now making the alterations in the central office the case requires.

SIOUX CITY, IA.—The Iowa Union Telephone company has completed its telephone connections between this city, Jefferson and Elk Point, S. D.

BLUEFIELDS, NICARAGUA.—There is much talk of the establishment of telegraph and telephone lines between Bluefields and Rama.

MOBILE, ALA.—It is suggested that a telephone line be established between Mobile and Fort Morgan, with stations along the eastern shore at important points.

SULLIVAN, MO.—The telephones of Sullivan county have been incorporated under the name of the Sullivan County Telephone company.

FILLMORE, N. Y.—Poles are being put up and the wire strung for a telephone from Fillmore to Centerville, and new poles are being set in place of the old ones between Fillmore and Pike.

GARRISON, COL.—The Garrison & Duncan Telephone company has been incorporated with a capital stock of $5,000 by Paul B. Gates, Wesley Staley, Charles R. Foster, Larin O'Ray, to operate in Garrison, Costilla county.

NORFOLK, VA.—Mr. Brown and J. A. Helvin have been granted a franchise by the City Council of Norfolk, Va , for constructing a telephone line in that city. By the terms of the franchise they are to put all the wires for their telephone system under ground.

MADISON, IND.—The new Telephone company is composed of the following: John W. Scott, Charles R. Johnson, William Kirk, William Allison Scott, Isaac Taylor, John W. Thomas and Ed. A. Marks. The authorized capital is $10,000.

FAIRVIEW, PA.—Mr. Osborn, of Oil City, who owns a grape farm about five miles south of Fairview, is laying out a private telephone route from Fairview station to his farm, and has already commenced operations.

OAKLAND, CAL.—A franchise has been asked of the City Council by a corporation known as "The Commercial Telephone Company of Alameda County," to construct and operate a strictly first-class telephone system in Oakland.

GOLDEN CITY, MO.—The telephone line between this point and Greenfield has been completed and is now in working order. Workmen are constructing the line from Jerico to Sheldon, and a line is projected from Arcola to Lockwood. A line will be built from this point to Lamar.

PATCHOGUE, L. I.—The New York and New Jersey Telephone company, which is stringing the entire island with its wires, now has Patchogue in telephone connection with outside cities. The company has eight wires, and all villages between here and Brooklyn are now in connection.

OMAHA, NEB.—Material has been ordered by the telephone company to build the two additional miles of subway which it has to lay under the ordinance recently passed by the city council compelling all telephone wires to go underground in a certain district.

BEECHER FALLS, N. H.—E. H. Bushey has just opened a telephone line from Beecher Falls to Sawyerville, P. Q., which takes in all the intermediate places and is 48 miles in length, connects with Bushey's Exchange here; and is owned by the Canadian Telephone Co.

MENASHA, WIS.—The Wisconsin Telephone Company is in trouble with the Menasha Council over its franchise ordinance. Through some defect which required a change, the ordinance was amended after publication, and now the company refuses to pay for a second publication.

BAY CITY, MICH.—The organization of the Saginaw Valley Mutual Telephone Company has placed a new and evidently a very strong rival in the field. This company has been practically promised a 30-year franchise by Saginaw, and will soon ask the Bay City council for a similar favor.

HUNTSVILLE, TEX.—Messrs. Turner and Burtis from Madisonville have been conferring with business men regarding a telephone line from Madisonville. Twelve hundred dollars in stock was readily subscribed, which, with the $400 taken by Madisonville, insures, it is said, the success of the enterprise. The capital stock will be placed at $12,000 with the view to extending the line to other points.

EAU CLAIRE, WIS.—E. B. Cottril, general superintendent, and T. J. Gallagher, superintendent of construction of the Wisconsin Telephone Company have returned to Milwaukee after a tour of inspection. Extensive improvements in Eau Claire are to be made at once, including new sixty-foot poles throughout. The early extension of the long distance line to Eau Claire from Madison by way of La Crosse is promised.

ALBANY, N. Y.—The new long distance telephone company has completed its organization when its capital stock $350,000 was paid up. The following officers were elected: President, John M. Bailey; vice-presidents, James Rooney and Henry Russell; secretary, Charles L. A. Whitney; treasurer, Howard Hendrickson; general manager, William A. Graves.

LANSING, MICH.—A company has been organized here to operate a new telephone exchange in competition with the Bell Co. It has a capital stock of $25,000 and proposes to commence business within sixty days. Its officers are: O. D. Hardy, president; George Cockburn, vice-president; Jacob Stahl, treasurer; D. A. Reynolds, secretary and general manager; Walter Pratt, superintendent of construction.

CHESTER, PA.—The Delaware County Telegraph and Telephone Company, recently organized, and which has an ordinance now before City Councils asking for a franchise, is meeting with favor on every hand. The rates for business houses and manufacturing plants are fixed at $30.00 per year, and for private houses the rate will be $20.00. The stock of the Delaware County company has been placed at $25,000, divided into 1,000 shares of $25.00 each.

MANKATO, MINN.—The Blue Earth Valley Telephone Company, a recently incorporated company, have been granted a permit by the city council to erect poles in this city, and to provide for a long distance service as well as local. The line will be built from Elmore north, via all intervening villages to a connection with the long distance telephones now in operation from Mankato to the Twin Cities, and will connect at Elmore with the Western Union system in Northern Iowa.

SACRAMENTO, CAL.—Through John I. Sabin, the president, the Sunset Telephone Company has sent circulars to the subscribers of the Capital Telephone Company, saying that by the use of the new telephone they would lay themselves liable for violating the American Bell Telephone Company's patents. The new company claim to have the advice of the leading patent lawyer in the United States, and feel secure in their position, as they have the assurance that the Columbia telephone in no way infringes on the existing Bell patent.

CHESTER, PA.—A second largely attended meeting of the telephone subscribers of this city and vicinity has been held. The committee appointed by a previous meeting to secure lower rates, if possible, from the Bell Company reported that nothing could be done with the old company. After a great deal of discussion it was decided to support the lately incorporated Delaware County Telegraph and Telephone Company, and a resolution to that effect was adopted. The old rate is founded on a basis of $66, with additional charges for additional distance, and the new company promises a $30 rate.

MISCELLANEOUS.

ELECTRIC FURNACES AND THEIR APPLICATION TO THE TRANSFORMATION OF CARBON INTO GRAPHITE.[1]—IV.

BY CH. STREET.

On August 1, 1893, M. Chaplet took out a patent for an electric furnace based on the researches of M. Moissan. These furnaces (Figs. 23 and 24) are those with which M. Moissan carried out those interesting investigations with which he has entertained the scientific world. I will not stop to describe the apparatus, which is well known to all.

Continuing our researches on the rotating arc we devised, in 1894, a type of crucible based on this principle. In this piece of apparatus the arc is influenced by a suitable magnetic field, and rotates more or less rapidly around the surface of the crucible and of the electrode. By this means we have succeeded in making the maximum use of the heat generated, and in effecting a uniform distribution of the heat so generated; this latter point is of considerable importance so far as the duration of the crucibles is concerned. The arc can be made to rotate either around the external or internal surface of the crucible, or around two independent electrodes, between which the crucible is situated.

In Fig. 25 is shown an arrangement which allows us to heat a crucible by an externally rotating arc, the arc revolving round the axis of the crucible in a horizontal plane. *v* is the carbon crucible, supported at the centre of the furnace by its rim, which rests on a ledge cut in the carbon block *a*, which is itself placed within another block of refractory material *g* of silica, magnesia, or some other suitable substance, this block in its turn resting on a slab of refractory material *f*, a similar slab *h* resting on the top of *a* and *g*. Finally, two blocks of carbon, *c* and *b*, complete the interior of the furnace. All these parts are contained within a metal tube, closed top and bottom by the covers *j* and *j'* by the intermediary of an insulating joint. The blocks *c* and *f* are pierced by a channel through which the carbon electrode *e* is passed, the shape of the electrode being such that it envelops the lower end of the crucible without touching it. The crucible *v* is kept pressed down on its seat *a* by means of a carbon plug *d* carried in the holder *l*, the latter being contained in the tube *k*, together with the spring *r* and the abutment ring *q*. The tube *k* is mounted on the upper cover *j'* by a bayonet joint, and is stopped at the top by a screw plug *p*, which tightly secures a sheet of mica. The carbon stopper *d* may be pierced at the centre by a hole *i*; through this hole and the mica the reactions going on may be followed. In attaching *k* to the top plate *j'* the stopper *d* presses upon the crucible *v* with a pressure proportional to the strength of the spring *r*. If the top and bottom plates *j'* and *j* are connected to the poles of the source of electricity, an arc will start between the crucible *v* and the carbon *e*. To cause this arc to revolve round the outside of the crucible we place outside the metal frame two solenoids, *s* and *s'* traversed by an electric current which obliges the arc to rotate in a plane perpendicular to the axis of the crucible and around the axis of the crucible as its axis of rotation. The crucible *v* is pierced at a certain height by a hole *y*, which is opposite a tunnel *t*, which is run through the blocks *b* and *g* and the metal frame. When the material introduced into the furnace *v* is capable of being fused by the high temperature attainable in it, the whole system is tilted round an horizontal axis, and the molten material flows away and is collected without interrupting the work of the furnace.

In Fig. 26 is shown an arrangement by which a crucible *v*

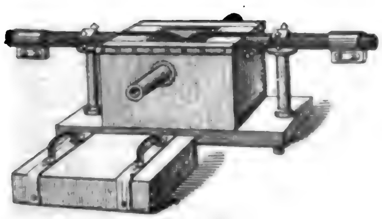


FIG. 23.

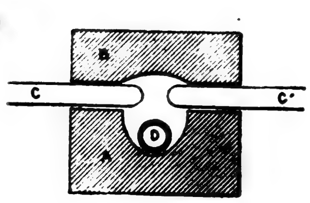


FIG. 24.

placed inside two tubes *a* and *b* is heated. The arc is stuck between the ends of the two tubes, and runs round under the action of a two-phase current. A crucible of this type has enabled us to effect in a few minutes the fusion of a 25 gramme nugget of platinum, and to reduce the oxides of manganese, uranium, and vanadium and also tungstic acid. The current employed was 80 amperes at 110 volts.

When the crucible is connected to the negative pole the metals obtained are highly carburized, and when the crucible is connected to the positive pole one obtains, if the operation is carried out with certain precautions, metals containing only a trace of carbon.

The electric furnaces devised by us have been made chiefly with a view to raising artificial carbons, such as they are now made, to an extremely high temperature. One of the most important factors in this process is the baking of the raw materials. The higher the temperature to which they are raised, the more valuable do they become; their conductivity and general qualities increase with this temperature, and are a function of the point to which the baking was carried. From the experiments we had made in this direction we foresaw that by raising the carbons to the highest temperature available we should obtain new and interesting results. To realize this programme we thought that the best way, and the one that would be the most efficient, would be that in which the arc was made to play actually on the surface of the carbon to be treated; a method which we were able to make use of

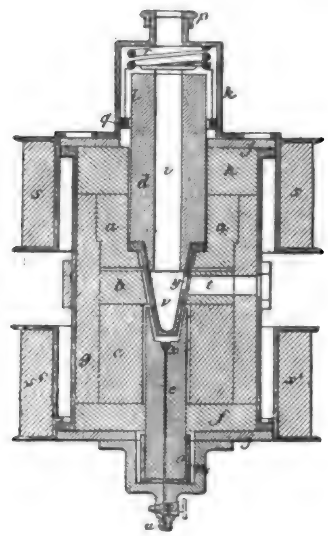


FIG. 25.

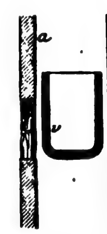


FIG. 26.

by means of our furnace. When two arcs are used in series on either side of a carbon rod or strip to which a translatory motion has been given, the arcs, if the current is relatively small, trace two generatrixes on the carbon, which are graphitic in character. The width of the line traced out by the arc is about 2mm., with a 14mm. carbon and a current of 40 amperes, and the depth of the graphite is about 1.5mm. In proportion as the internal temperature of the furnace increases, the region of change widens and deepens. At the end of a certain time the carbon treated, which presents excrescences and hollows at the spot touched by the arc, still retains its shape absolutely unaltered, though it is entirely transformed into graphite, or rather the extent to which the transformation is carried becomes uniform throughout its mass. From this moment the arc no longer has its customary filiform appearance. When an alternate current is employed the carbon electrodes and the carbon under treatment appear to be the seat of a volatilization of carbon over their entire surface, as is shown by the appearance of the ends of the electrodes and of the surface of the carbon that has been transformed.

When rotating-arc furnaces are used, then at the beginning of the experiment, and when the rate of translation of the pieces undergoing treatment in the furnace is exaggerated, the pieces exhibit on their surfaces the marks of a helix of graphitic carbon. The pitch of the helix varies for the same current with the speed of the carbon, and with a suitable speed the entire surface becomes graphitic. The wear of the carbons in these furnaces is extremely small.

In the case of rotating arcs the currents used are continuous, the piece undergoing treatment forming the positive pole. This arrangement has the advantage of placing the fixed electrode in the best condition for continuous work without the necessity of any mechanism for adjusting the length of arc.

In the case of furnaces in which the pieces to be treated pass between two fixed electrodes we employ preferably alternate currents. Owing to the small wear of the electrodes it is only necessary to adjust them by hand every hour. This consumption is 5mm. for a 300 ampere current and 40mm. electrodes. When the furnace has settled down to its work it is perfectly regular in its action; the ammeter placed in circuit remains absolutely steady, and the voltmeter across its terminals enables the length of the arc to be regulated with the greatest possible nicety.

MAGNETIC UNITS.

At the recent meeting of the British Association, the Committee on Magnetic Units handed in a report suggesting three additions to the nomenclature of magnetic science, as follows:

(1) That as a unit of magnetic field 10^8 C.G.S. lines be called a *weber*.

NOTE.—A *weber* added per second at a steady rate to the

field girdled by a wire circuit induces one volt in every turn of that circuit.

(2) That the C.G.S. unit of magnetic potential or magnetomotive force be called a *gauss*.

NOTE.—An ampere-turn corresponds to $\frac{4\pi}{10}$ (or 1.2566) *gauss*.

Hence the number of *gauss* round any closed curve linked on an electric circuit is equal to $\frac{4\pi}{10}$ times the number of ampere-turns in the circuit.

(3) That the termination *-ance* be used in general for words expressing the properties of a definite body or piece of matter; *e.g.*, resistance, conductance, inductance, permeance, etc. And that the termination *-ivity* or *-ility* or the like be used for words expressing the specific properties of a material; *e.g.*, conductivity, resistivity, inductivity, refractivity, permeability, etc.

During the discussion which followed the submission of the report Prof. S. P. Thompson pointed out that the *weber* had already been adopted in America as the C.G.S. unit of flux. He also remarked that the unit which it was proposed to designate the *gauss* in the report had already been named the *gilbert* by the American Institute of Electrical Engineers, and the *gauss* was here employed as the unit of magnetic flux density.

A PORTABLE MAGNETIC FIELD TESTER.[1]

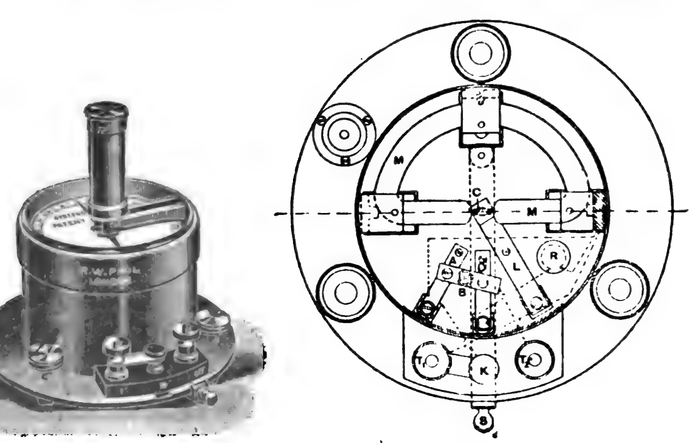
BY W. E. AYRTON AND T. MATHER.

The instrument is shown in Fig. 1, while Fig. 2 gives a sectional plan. A circular base provided with levelling screws carries a C-shaped magnet M (Fig. 2), between the poles of which the coil C is suspended. The discharges are led into and out of the coil by the suspensions, one being a straight phosphor-bronze strip, and the other a spiral surrounding the straight strip. Both suspensions are attached to an ebonite head near the top of the central tubes, this head serving the purpose of zero adjustment, and the arrangement is such that the whole of the suspended parts can be readily withdrawn.

The arm carrying the suspension head overhangs the scale, so as to permit of the pointer making one or more complete revolutions, and in this way an instrument having a very long range is obtained. For example, the body of the instrument shown in Fig. 1 has a diameter of 4 in., and the length of the scale, reckoning only one revolution of the pointer, is about 11 in. As it is quite possible to use 1½ or 2 revolutions without straining the suspensions unduly, we have here an instrument with a scale as long as that of an ordinary reflecting galvanometer (18 in.) in a very compact form.

To increase the range of the instrument still further, and to make the instrument suitable for measuring the stray magnetic field in close proximity to dynamos, pole-pieces, &c., a switch, S (Fig. 2), is arranged to put a resistance coil R in series with the suspended coil, thus multiplying its range by 10. The same switch, when moved to the position OFF (Fig. 1) breaks the circuit of the instrument and lifts a spring, L (Fig. 2), which clamps the coil. A short-circuit key, K, on the front of the galvanometer is used to bring the pointer to rest, for when this is pressed the motion of the coil becomes aperiodic.

The scale of the instrument is divided into 200 parts, and as a



FIGS. 1 AND 2. AYRTON AND MATHER'S PORTABLE MAGNETOMETER.

field tester the sensibility is such that with an appropriate test coil the scale reads off directly the strength of field in C.G.S. units.

For some purposes it is convenient to have the scale graduated in microcoulombs, in which case, besides reading the quantity directly, the swing of the instrument multiplied by the total resistance of the galvanometer circuit measures the total change of induction through that circuit. Such a scale is useful in testing iron for permeability, &c., for by suitably arranging the resistance of the circuit the scale reading can be made to read off *B*, the the induction density, directly.

The instrument embodies a sector shaped coil of narrow angle, and the authors give a table showing that the long narrow coil has considerable advantage over common shapes as regards sensibility.

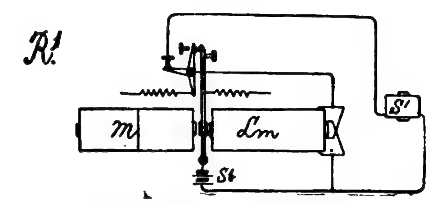
1. Abstract of a paper read before the British Association at Ipswich.

A NON INTERFERENCE DIPLEX RELAY.[1]

BY D. H. KEELEY.

The device designed by the writer and illustrated below has been satisfactorily tested on a regular quadruplex line.

In the receiver R¹ an auxiliary electro magnet Lm, wound to produce a considerable counter E. M. F., is placed directly behind the relay armature so as to act thereupon in opposition to the



KEELEY DIPLEX RELAY.

main circuit coils M. In the normal condition, with no current traversing M, the armature lever is held against its back stop by a light retractile spring in the usual way. When a weak current, say the minimum, traverses M, the armature lever is attracted to the intermediate position; this closes the circuit of both Lm and S¹; the retractile power (that is, what the magnetic attraction in this case becomes) of Lm is delayed by its own counter E. M. F. until the attraction of M has grown sufficient to retain the armature in the position to which it was drawn, so the closed circuit of S¹ remains undisturbed. The same action attends the intermediate current; so S¹ responds to the minimum and intermediate currents. When the maximum current traverses M, the armature lever is carried from its intermediate position, and S¹ opens, but the circuit through Lm remains uninterrupted. If the current again decreases, the lever returns to its intermediate position, and S¹ closes; but if the maximum current is entirely withdrawn, the armature lever will, in consequence of the steady pull exerted on it by Lm, be drawn sharply back to its rear limiting stop. And if, when the armature is resting in the latter position, the maximum current is applied to M, the armature lever will pass directly over to the front limiting stop, in consequence of the counter E. M. F of Lm robbing it of any retractile power during its passage across the contacts in the intermediate position. There is, therefore, no hindrance to the forward movement of the armature, and there is an acceleration of its movement rearward; hence the maximnm current can be applied and withdrawn at pleasure, without in any way affecting the local circuit by which the sounder S¹ is operated.

Assuming the action of this instrument to be understood in the light of the foregoing, it will be perceived that if it were employed as the neutral relay in the polar diplex, the local connections might be so modified that the sounder S¹ would not be affected by the current reversals, while it would be responsive to the increment key.

RECENT RESEARCHES ON LEAD ACCUMULATORS.

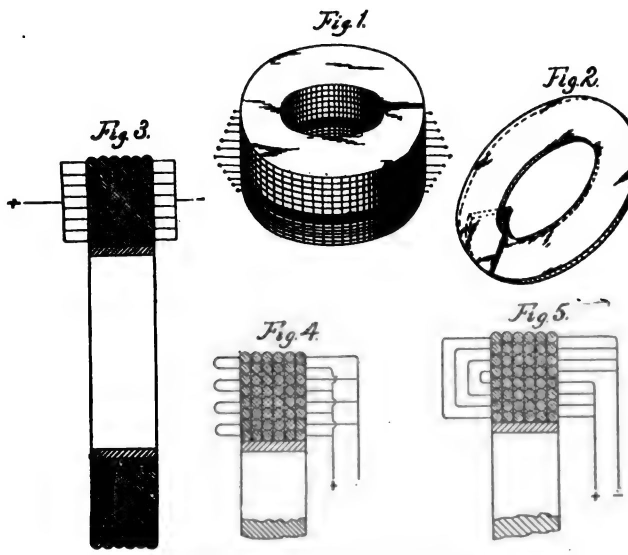
Our readers are probably familiar with the theory of M. G. Darrieus, which embraces the chemical reactions which take place in lead accumulators. According to this theory, an important *rôle* is played by the free persulphuric acid which is formed: in fact, the theory claims that this acid is the really active agent, and that during charging it is formed at the positive electrode, converting the lead oxide and sulphate into peroxide, any excess being decomposed into sulphuric acid and oxygen—a fact which indicates when the charging is finished. K. Elbs and O. Schönherr have recently been investigating the formation of persulphuric acid (*vide Zeits. für Elektrotechnik u. Elektrochem.* 1895, pp. 417–421, and 468–472), and they now point out (*ibid*, pp. 473, 474) that Darrieus's theory is not in accord with the results which they have obtained. They state that with the small current densities which are usually employed in accumulator work, only very small quantities of persulphuric acid would be formed, even when the acid has the unusual high specific gravity (1.3) employed by Darrieus. They are aware that their results are not entirely in accord with some recent experiments by Schoop; however, they argue that in accumulators the only matter for consideration is the question of a solution of free persulphuric acid in free sulphuric acid. They admit the large quantities of persulphuric acid can be met with occasionally in charged accumulators; but

1. Abstract of a paper read before the Canadian Electrical Association.

they are of opinion that this acid is present only as an accidental and secondary product, and that it is impossible that it should play the part assigned to it by Darrieus.

THE SCOTT TRANSFORMER WITHOUT FOUCAULT CURRENTS.

FOR many reasons it is desirable to wind the secondaries of step-down converters in such a form as to obtain a greater depth than breadth, the breadth of the converter coil being measured along its axis. With a given proportion or given outside measurement of a secondary coil, it is often very inconvenient with the sizes of wire at hand to produce a coil having the number of



FIGS. 1, 2, 3, 4 AND 5. SCOTT'S TRANSFORMER.

turns requisite in any given case. It, therefore, becomes desirable to employ fine wire, which, by superposition and use in multiple arc, can be made to build up, so to speak, the desired form of total wire for the filling up of the available space and at the same time the attainment of the desired number of ampere-turns. In the next place it is found that currents in the primary and secondary coils of a converter tend not only to send lines of force through their common axis, but also to send lines between the coils in the plane separating them and also through the coils themselves in a direction parallel to that plane, that is, leakage lines. The result of such an alternating field is the setting up of Foucault currents in any conductor which has a considerable width in the direction at right angles to the direction of the leakage-lines.

Supposing the primary and secondary to lie side by side, as shown in Fig. 1, the leakage-lines will take the path indicated approximately by the small arrows, and it is therefore desirable that the windings on the secondary, where large wire or its equivalent must be used, which is the case in step-down converters, should lie so that the width of conductor shall be in a direction at right angles to the axis of the two coils, or, in other words, shall coincide as far as possible with the direction of the lines of force. This arrangement is attained very perfectly by the use of single broad hoops, such as shown in Fig. 2, employed side by side, as indicated in Fig. 1; but in some cases it is desirable for certain reasons to employ wires instead of flat hoops, and with this object in view Mr. C. F. Scott of the Westinghouse Co. in a recent patent describes a converter in which he employs small wires in the secondary of a step-down converter and arranges them that they shall have all the advantages of the flat hoop-conductor shown in Fig. 2, without the disadvantage incident to the manufacture of the latter.

In accomplishing the above-named object Mr. Scott winds the fine wire one or two layers at a time, cutting off the end of each layer or pair of layers and leaving the ends loose until the whole secondary has been built up. The opposite ends of each annular single or double coil are then respectively connected together and the arrangement shown in Fig. 3 or Fig. 4 is thus attained.

In Fig. 4 is shown a modification of this arrangement wherein two layers are completed before the wire is cut. This form is more convenient than the other, inasmuch as all the ends come out at the same side of the coil, as is shown.

A certain disadvantage exists in the forms shown in Figs. 3 and 4, from the fact that the distribution of current throughout all the wires of a given annular section is not uniform. This objection may be overcome by the use of the form shown in Fig. 5, wherein the wires are wound in pairs of layers; but the pairs are not successive. The innermost layer, being finished, is carried around to form the beginning of the outermost layer, and thus a constant average length of all the branches in multiple arc is secured.

GLOBULAR LIGHTNING AND ITS EFFECTS.

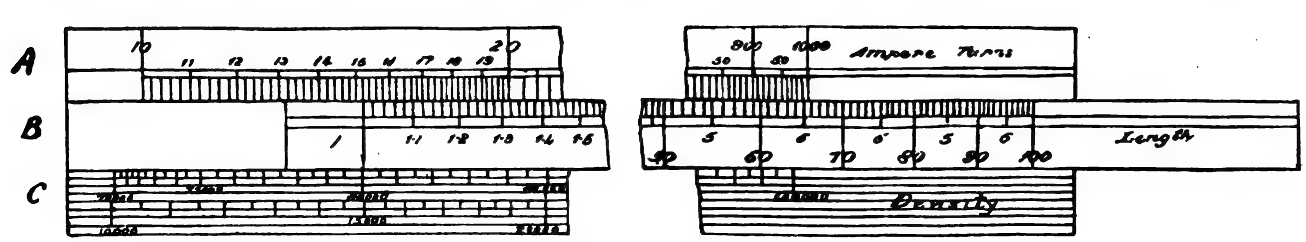
A correspondent of *Nature*, G. M. Ryan, writes as follows, from Karachi, India:

On June 21, about 6 P.M., Dr. Wallis, Mr. Taylor and myself were in our drawing-room on the ground floor, taking shelter from a passing storm; they were seated, and I stood five paces from them. The doors were all closed against the storm, and I went out and, for cool air, opened one. On returning, I saw a globular light, about the size of the full moon, in the air between Wallis and Taylor, and almost instantly I heard in the room a terrific clap of thunder, like a cannon. I suffered afterwards from acute pain down the left side of my face. Taylor, who had an iron-headed golf stick in his hand, felt a twinge up his right arm, and a sensation as of singeing in his hair. Wallis felt nothing at all. We all experienced a sulphurous smell. In the adjoining room, leaning against one corner, were two Martini-Henry rifles in leather cases. One was untouched. The stock of the other was almost shattered, splinters lying about the room. The leather covering of the splintered rifle was torn, but the metal part of the rifle quite unhurt. At the point of the wall where the muzzle of the shattered rifle touched the wall, there was a hole 5 x 2½ and 1½ to 2 inches deep. The wall is of mud and plaster. In the room above were two holes in one wall; that is, the wall above that in which the hole appeared below. These holes were smaller than the one below. Just below the two holes stood a wooden case, iron-bound, and at its foot the matting was torn up, but the floor and the case were untouched. In the second room above, that is, the room over that in which I had seen the globular lightning, the wall near the ceiling was cracked for six or eight feet. This was all the damage done that we could find.

SLIDE RULE FOR CALCULATING MAGNET WINDINGS.

In a series of articles on dynamo design appearing in the London *Electrical Review*, Mr. Claude W. Hill describes a slide rule designed for the purpose of expediting the calculation of magnet windings. The rule, shown in the accompanying illustration, has three scales, A, B, and C; A represents ampere turns, B the length of magnetic circuit, and C the magnetic density per unit of sectional area. Scales A and C are fixed, and B is the slider. To determine the ampere turns required for a given magnet, the arrow head on scale B is brought opposite the required density on scale C, and opposite the length of magnetic circuit on scale B will be found the correct ampere turns on scale A. Thus, in the figure the arrow head is opposite 80,000 per square inch density, and for a length of magnetic circuit of 60 inches there are required 910 ampere turns.

The scale C may be made detachable and a set of C scales may be kept, divided for different materials such as cast-iron, wrought-iron, and the various makes of special steel, dowels being fitted on the slide rule, and the C scales having corresponding holes to insure their being placed in the correct position. The author has used one of these slide rules (a home-made one) for the last eighteen months or so, and has found it a great assistance.



SLIDE RULE FOR CALCULATION OF MAGNET WINDINGS.

THE "POROUS-PLANTE" STORAGE BATTERY.

The aim in all storage battery constructions is to obtain the highest possible storage capacity with the minimum of weight, combined with a construction which will ensure long life. To secure these desirable qualities many types of plate have been devised but more recently there appears to be a decided tendency to revert to the original Planté type of cell or some modification of it, as distinguished from the Faure or Brush type, in which the active matter is applied to the plate.

The most recent cell of this kind is that devised by Mr. J. Hart Robertson. It has been called the "Porous Planté," on account of its peculiar structure.

The plates of this cell are not made porous by pressing a number of particles together, but each consists of one continuous mass of lead with a sponge-like formation which gives a very

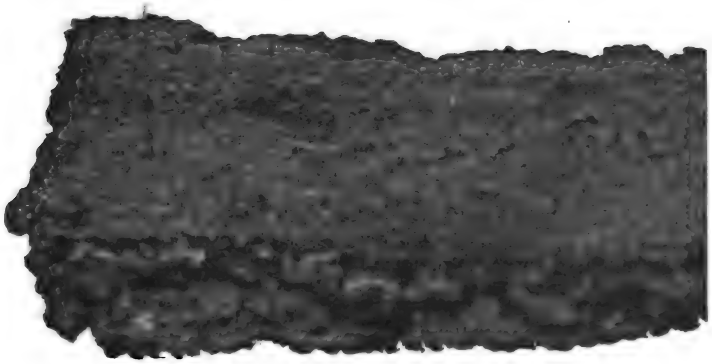


FIG. 1.—SECTION OF "POROUS PLANTÉ" STORAGE BATTERY PLATE.

large surface whether the plate be thick or thin. The active material that is formed from the lead by electrolytic action is held securely in the innumerable irregularly shaped cells and corrugations throughout the body of the plate.

The method of manufacture is the following: Pumicestone is used in a granulated state and is mixed with lead when the same is in a pasty condition, and kept in that condition, by proper heat regulators, until the mass is well kneaded, when it is pressed into a mold of the required shape, and left for a minute to cool. In the act of mixing, the heat expands the air in the pores of the pumicestone, which expansion causes a multitude of cells to form throughout the lead. An examination of a section of a plate with a microscope shows that for every particle of pumicestone seen, there are hundreds of thousands of minute cells formed by the tendency of the heated air to force its way out.

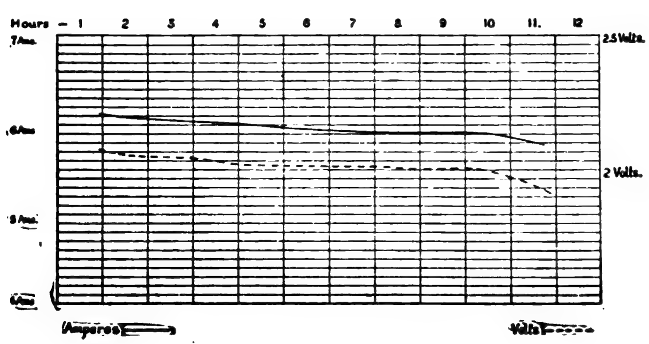


FIG. 2.

The porosity of these plates is such that a plate 9x7½ inches, will hold about 5½ ounces of water.

The particles of pumicestone can be eaten out of the lead by a simple process, if desired, but as there is only 10 per cent. of solid matter in it, and being electrically inert, it makes no difference whether it is left in or taken out. It is obvious that this method allows of great variations in the porosity, and therefore in the weight of the plates, but it is found that 50 per cent., in bulk, of pumicestone (the weight of the pumicestone is practically nothing) is a fair average amount to use.

A cross section of a plate is shown in Fig. 1, and Fig. 2 is a diagram of discharge of a 15 pound cell which was formed in 140 hours with a current of one ampere per pound of lead. This is rated as a 50 ampere hour cell, but an examination of the diagram will show that it gives considerably over that amount.

It has been mentioned that plates of this kind can be made either thick or thin and have an equal amount of porosity. While the porosity is the same, it has been found advisable, after a long series of comparative tests, to discard very thick plates for those ⅛ to ¼ of an inch in thickness. Plates one inch thick, although of the same porosity as the thinner ones, take longer to form and also have a much lower rate of charge and discharge per pound of lead. This is probably due to the inner part of the plates being so far away from the plates of opposite polarity on either side, and also partly to local action, due to the outer surfaces sulphating before the inner part.

It is obvious that, in special cases, where lightness is of paramount importance, even at the sacrifice of a part of the life of the battery, this can be obtained, with the same high efficiency, by reducing the thickness of the plates to the required extent, or increasing the porosity, or both. For ordinary purposes where a light battery is desired, it is deemed desirable to have the plates ⅛ of an inch in thickness; and for stationary plants, ¼ of an inch in thickness.

The patents under which the Porous-Planté cells are manufactured are owned by the Standard Storage Battery Co., of 50 Exchange Place, New York, and arrangements are now being made looking to the active manufacture of these cells.

ELECTRICAL WORK IN AUSTRALIA.

MR. LEE L. MURRAY, the Australian representative of the firm of Siemens Bros. of London and Siemens & Halske, of Berlin, writes us from Melbourne as follows:—"We in Australia are not doing very much, as you will perhaps have seen that the business depression throughout Australia is quite unprecedented; and business people are living in the hope that business will improve.

"Last year we finished a contract for the Hobart Electric Tramway Company, Ltd., at Hobart, Tasmania, equipping about 10 miles of track on the overhead wire system, the construction of which is similar in most respects to the usual American practice. They have 20 motor cars (50 passengers each), 3 Siemens dynamos, each 250 amps., 500 volts, direct coupled to Willans engines.

"I was a little curious to know how these high speed engines would govern under the tremendous changes of load that occur in a street railway system, but having once seen the splendid way they do the work, shall not hesitate to always recommend them in future.

"We are now engaged putting in a lighting plant for the Launceton Corporation (Tasmania). Here we have water power about a mile and a half from the city, and are putting in 5 Siemens constant current dynamos, 7 amps., for 85 arc lamps in series and 3 Siemens alternators 100 K. W. each, 2,000 volts. Each machine is directly coupled to a turbine of Thompson's vortex wheel type.

"These and the Melbourne City Council work, which was secured by the General Electric Company of New York, who are supplying Thomson-Houston machinery, are the principal plants that have been done recently in this land of kangaroos and sunshine."

PNEUMATIC BICYCLE TIRES AS AN INSULATION.

Bicycling has many advantages, and a new one due to the pneumatic tire has been brought to light by the *Scientific American*, which says: "The rider is completely insulated from the earth and consequently is impervious to the attacks of the electric fluid. Thus, day by day, it becomes more and more a fact that life without a pneumatic tire is neither safe nor worth having. Anyone who suffers from nervousness during a thunder shower has now only to go into a barn or the cellar and seat himself on the saddle of a pneumatic-tired bicycle to be perfectly safe from lightning stroke. As the chances of a man on a bicycle being struck by lightning have been carefully calculated to be about one in a billion, there will, of course, be some pessimists who will deny that this newly discovered virtue of the pneumatic as a lightning insulator amounts to much."

THE USEFULNESS OF THE DATA SHEETS.

Mr. Geo. S. Macomber, the dealer in electrical house furnishings, of Perry, N. Y., writes us as follows:—The morocco filing case arrived in due time; it is much better than I expected. The Data Sheets are fine. I hope that the next step will be to publish them regularly each week, and may that step be taken soon. I hope the suggestion offered by Mr. Paul Lupke, as to the separate dates will be put into effect; also the blank sheets. I would like some now. As still another suggestion, I would ask would it not be well to publish a classification sheet, with the entire four figures, thereby enabling us to classify our written sheets more accurately. Also would it not be well for those who have valuable data on these subjects to forward it to you for publication, for I think that many very good notes will be written which would otherwise escape your notice; and in this way all such could help many of their fellow workers.

NEWS AND NOTES.

THE ATLANTA EXPOSITION.

(From our Special Correspondent.)

WORK on the Exposition is being rapidly pushed to its completion and in a few days the finishing touches will be done, giving to the world a triumph of the largest undertaking of this kind the South has ever attempted. The topography of the grounds is more pleasing than that at Chicago. The site of the exposition is a beautiful tract of land of two hundred acres, about two and one half miles from the centre of the city, but having ample steam and electric transportation. From the Administration building looking east is a sight which has caused many visitors to stop and linger. This building with its grand entrances stands on a summit which slopes down in a circle from each side, within the arms of which is the grand plaza with its beautiful fountain, and ending on the far side with the beautiful lake "Clara Meer."

Chas. A. Foster.

The whole ground is a rolling piece of land beautifully terraced and covered with grass and honeysuckle.

The walks of the large avenues are paved with crushed limestone and are bordered with grass and flowers. Broad stone steps buttressed with masonry of huge Georgia granite, reach up these terraces, while a grand stairway of these huge steps leads down from the plaza to the lakes. All over the grounds are dotted lofty Grecian columns surmounted by statues of white and bronze, illustrating History and the Arts.

The Electricity Building which is pronounced by many to be the most beautiful building on the grounds is being rapidly filled. The Electrical Department, under the direction of Chief Chas. A. Foster, ably assisted by his assistant, Mr. Lem. S. Boggs, is perhaps the most complete and systematically arranged department of the exposition. A number of electrical men from various points have already visited the grounds and express themselves as well pleased. Mr. Oliver Kinsey, President of the Post-Glover Electric Co., of Cincinnati, who have one of the most attractive exhibits in the Electricity Building has been down for a week shaking hands among his co-workers. Mr. Rocafellow and wife of the Western Electric Co., are spending this week on the grounds. Mr. W. M. Brooks of the Central Electric Co. is in town now mixing the pleasures of the Midway with business.

L. S. Boggs.

Mr. Luther Stieringer is perhaps one of the busiest men in the whole grounds. He promises to have the fountain in working order in a short time now.

Quite a novel scene was presented last week while the divers were building the coffer dam around the burst pipe that led down under the lake from Machinery Hall to the fountain. Among those at work every day upon this pipe has been a woman diver who has rendered valuable assistance.

PROFUSE SPECIAL LIGHTING AT OMAHA.

During the State Fair week, at Omaha, the city council ordered a most profuse display of special electric lighting, putting 10 extra arcs on a large number of blocks, and 160 incandescents on others, with festoons at street intersections. The city hall was profusely illuminated and a huge star, 17 feet in diameter, containing 225 red, white and blue lights was flashed in and out. Many of the large private buildings followed suit.

ELECTRICAL PLANT FOR NEW ENGLAND POWDER WORKS.

SINCE the recent explosion at the mills of the American Powder Company, South Acton, Mass., wherein five men lost their lives, the company has been making extensive alterations in the works. An electric plant is being put in, which will do away with five engines and nine water wheels. There have been put up 10 new mills, and several others are now being erected. Electricity is adopted as a safeguard.

QUINCY, ILL., ASKED THE POSTAL TELEGRAPH COMPANY TO DIVIDE ITS PROFITS.

THE Postal Telegraph Cable company has declined to accept the right of way into and through Quincy on the ingenuous terms offered by the city. The conditions imposed were that after the first year the company shall pay into the city treasury 2 per cent. of the gross receipts of the Quincy office. The Western Union has been in the town forty years with free privileges, and the Postal thinks it is at least entitled to as much, without paying percentages on its gross receipts.

AMERICAN ELECTRICAL APPARATUS IN RUSSIA.

MR. G. WILFRED PEARCE writes: "The Russian government will admit electrical, light-house, and certain kinds of railway apparatus free of duty for four years from the 16th inst.

"There is a good market in Russia for electrical railway, power and lighting apparatus of the best types, made under sound patents, but it is useless for United States makers of electrical apparatus to endeavor to sell in Russia any machinery of inferior quality, or made under weak patents, as the imperial engineers have a system of records of inventions of every kind patented by inventors since 1688."

DESTROYING INSECTS BY ELECTRICITY.

Some successful experiments for destroying moths, &c., in forests were made a little while ago in Saxony. A revolving search light was erected and set to work. Large numbers of insects were attracted and were then killed by an incandescent platinum screen, which was fixed around the lamp.

POLICE TELEGRAPHY IN NEW YORK.

The number of messages sent over the wires of the New York Police Departments amounts to more than 1,000 a day. Last year the exact number was 378,388. The year before it was less by only 4,000. This branch of the Police Department is one of the oldest of the bureaus, and it has been much improved during the year through the undergound service of the subways. Of the messages sent last year 20,580 were calls for ambulances, 10,541 were alarms of fire, 7,245 were announcements to the Department of Public Works of obstructions in some precincts. Nearly 5,000 related to accidents on the streets, and nearly 4,000 were notifications of sickness; 4,312 telegraphic messages sent over the police wires related to the business of the Coroners' office, 3,400 to the Society for the Prevention of Cruelty to Children, and 1,030 to the discovery of property for which owners were sought. In addition to these special telegraphic messages sent out on various subjects, there were the so-called general alarm messages relating to police business. The maintenance of the police telegraph system costs in a year a considerable sum. The Superintendent of Telegraphs gets $3,000. His first assistant gets $2,000, and there are seven operators who receive $1,500 a year each. The sum of $50,000 was appropriated to the police telegraph system this year, and $35,000 to the work of placing telegraph and telephone cables under ground in 1895. These items are exclusive of cost of materials needed, which foot up $2,800 in a year, besides which there are three linemen and one battery man in charge of the police wires.

A CABLE FROM BREST TO NEW YORK.

Le Figaro says that M. Lebon, Minister of Commerce, announces that a contract has been signed for laying a submarine cable between Brest and New York, and for a link between the French cable system and the Antilles.

LAYING A CABLE TO HAYTI.

THE United States and Hayti Cable Company, in which officials of the Postal Telegraph and Commercial Cable Companies are prominent, has chartered the cable steamer "Mackay-Bennett" for the purpose of laying the first section of a submarine cable to connect New York direct with Hayti, West Indies. Last week the Mackay-Bennett submerged the heavy shore end cable, about ten knots long. The cable terminates near the landing place of the Commercial Company's cables at Coney Island.

PRAISE FROM INFLUENTIAL QUARTERS.

We have no co-worker more esteemed than our neighbor, THE ELECTRICAL ENGINEER. It is doing excellent work in every department of its special field, and we are learning from its columns continually. It has presented the facts in connection with electric traction very fully and fairly. It has been specially faithful and constant in its efforts for the safety of electric traction.—*American Machinist.*

Society and Club Notes.

BROOKLYN INSTITUTE OF ARTS AND SCIENCES.

The first meeting of the Electrical Department of the season '95-'96 was held in the Art Building, Montague street, Friday, Oct. 4. Mr. James Hamblet, president of the department, introduced Mr. T. C. Martin with his illustrated lecture "Niagara on Tap." The interest in the subject was apparent from the size of the audience and augurs well for the success of the department during the year, about 400 people being present.

Personal.

Mr. Geo. F. Sandt has been appointed Superintendent of the Georgia Electric Light Company, Atlanta, Ga., and left for the South some days ago to enter upon his duties. Mr. Sandt is well known in the electric business, having entered it in 1885, after having graduated at Lafayette College in 1882 and Stevens Institute in 1884. His first connection in the electric business was with the Engineering Department of the Edison Company for Isolated Lighting, which was afterwards absorbed by the Edison Electric Light Company. During his connection with this Company he installed the Edison system at Easton, Pa., his home, and designed the switch boards for the Milwaukee Street Railway Company, the Cincinnati Edison Electric Light Company and the Edison Electric Illuminating Company of Rochester. He was also in charge of the laying of the underground tubing for the up town station of the Edison Electric Illuminating Company of New York in 1887.

Mr. Sandt resigned his position with the General Electric Company in February, 1893 and was appointed Secretary and Treasurer of the Electrical and Mechanical Engineering and Trading Company, which position he held until March, 1895, when he resigned to take up contracting work through New Jersey, which he carried on until his appointment in the South. Mr. Sandt will be glad to see his friends, when they go South to see the Exposition.

Mr. Enos M. Barton, president of the Western Electric Co. will, it grieves us to learn, be likely to remain a sick man for some time to come, owing to the slowness with which his wounded leg heals. We only express the feeling of a very large electrical circle in desiring for him a speedy recovery from an illness that has been borne so patiently, but which is unusually irkome to one of his active disposition.

HELMHOLTZ AND SIEMENS.

A statue group of Helmholtz and Siemens is to be put up in front of the Technical High School in Berlin.

Obituary.

SIGMUND SCHUCKERT.

We regret to announce the death of Sigmund Schuckert, the founder of the firm of Schuckert & Co., of Nuremberg (now the Elektricitäts-Aktiengesellschaft), and one of the most energetic of the pioneers of modern electrical development in Germany, and to whose active interest in the industry much of the excellent work accomplished is due.

Reports of Companies.

ROCKAWAY ELECTRIC LIGHT CO.

An attachment for $10,451.43 has been filed against the Rockaway Electric Light Company of No. 121 Liberty Street, New York City and at Far Rockaway, in favor of the Complete Electric Construction Company, on notes and for money advanced.

EDISON EARNINGS IN NEW YORK CITY.

The following are the earnings for the New York Edison Co. inclusive of the Manhattan and Harlem companies, for August:

	1895	1894	Increase.
Gross	$122,547.50	$112,926.23	$9,621.27
Net	53,015.03	43,690.76	9,324.27
Gross, 8 months	$1,194,173.80	$1,046,279.06	$147,894.74
Net, 8 months	584,255.04	498,758.33	85,496.71

THE OFFICERS OF THE ELECTRIC STORAGE BATTERY CO. OF PHILADELPHIA.

The Board of Directors of the Electric Storage Battery Company will shortly be increased from seven to fifteen. Four of the new members will be from Philadelphia and four from New York. The following Philadelphia gentlemen have accepted the invitation to become members of the Board:—Mr. George Philler, President of the First National Bank, also Vice-President and Director of the United Gas Improvement Company, and Director of the Welsbach Commercial Company, the Fidelity Insurance, Trust, and Safe Deposit Company, the Real Estate Trust Company, the Southern Cotton Oil Company, the Pennsylvania Steel Company, and Chairman of the Clearing House Committee of the Philadelphia National Banks. Mr. Clement A. Griscom, President of the International Navigation Company, also Director of the Pennsylvania Railroad Company, the Cramp Ship and Engine Building Company, the Fidelity Insurance, Trust, and Safe Deposit Company, the Bank of North America, and the United Gas Improvement Company. Mr. Rudolph Ellis, a Director of the Third National Bank, the Manhattan Trust Company of New York, the Louisville & Nashville Railroad Company, and the Fidelity Insurance, Trust, and Safe Deposit Company of Philadelphia. Mr. William D. Winsor, Director of the Boston and Philadelphia Steamship Company, the Bank of North America, the Insurance Company of North America, and the Western Saving Fund. It is expected that the four new Directors to represent New York will be selected and the names announced this week. They will all be prominent and representative business men, and well known in financial circles. It is understood that Mr. George Philler will be chosen Vice-President of the Company.

HOEFGEN, MOXHAM & CO.

The above concern has been organized by John B. Hoefgen and Edgar C. Moxham, and is now carrying on a business as contractors and general supply agents at 80 William St., New York. Mr. Hoefgen was until lately the manager of the Nassau Electric Railway in Brooklyn, and built the road. The concern has issued a very neat and handy catalogue, and will be glad to attend to any business coming up in its line.

MANSON ELECTRIC CO.

The Manson Electric Company has been organized in New Haven, Conn., consisting of G. M. McKenzie, Duncan McArthur and D. E. Manson. Messrs. MacKenzie and McArthur are the successors to the F. C. Cannon Mfg. Co. and represent the Dodge Mfg. Co. of Mishawaka, Ind., carrying a stock of pulleys, shaftings, couplings, etc. Mr. Manson was with the Thomson-Houston Electric Co. at Lynn, during 1892-93, and more recently with the Denison Engineering Co. of New Haven. The new company will undertake repair and general contract work.

The Werner-Schenck Company, of Milwaukee, has filed articles of incorporation for the purpose of dealing in electrical supplies. The capital stock is $6,000. The incorporators are F. M. Werner, Arthur J. Schenck and F. P. Werner.

The D. E. Boswell Co. has been formed at Chicago with a capital stock of $2,000, by D. E. Boswell, A. A. Brown and T. B. Lambert to make electrical apparatus.

Legal Notes.

SCHLESINGER RAILWAY PATENTS IN PHILADELPHIA.

The United States Circuit Court in Philadelphia is about to try the suit of John J. McDuffee, trustee for Susan A. McDuffee, Alfred H. Williams and Wm. M. Schlesinger, against the Electric Traction Company for alleged infringement of the Schlesinger patents.

The Schlesinger patents were issued in March, 1886, and in the early part of September. The second patent was granted upon an application filed nearly ten years ago, but issued only since the institution of the suit. The first is for the attachment indicating visibly or audibly the exact location of an electric defect, and the second, applied for before trolley lines were in general use, covers an invention which comprises the provision of a number of separate feeders that extend in multiple arc relation from the bus bar or terminal of a generator station along the line of a railway and connect with the various sections into which the trolley wire is divided, together with automatic safety devices that prevent the passage of dangerous currents of electricity through these feeders.

Valentine and Brown, of Philadelphia, have communicated with Baltimore companies' officials, and also with those of the trolley lines in New York, Boston, Brooklyn and other cities, notifying them of their intention to sue for infringement of these patents.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED OCT. 1, 1895.

Alarms and Signals:—

Electrical Indicating Mechanism, F. J. Russell, New York, 547,085. Filed April 15, 1895.
An electric indicating and controlling mechanism whereby the pilot of a vessel may be informed as to the condition of his running-lights, both by visible and by audible indications, and whereby when a lamp happens to go out another lamp is immediately lighted in place of it.
Electrical Safety Apparatus for Railways, L. W. Briggs, Chicago, Ill., 547,240. Filed Aug. 24, 1893.
A train entering upon a section of track or "block" upon which a train is approaching from the opposite direction is automatically arrested.

Conductors, Conduits and Insulators:—

Insulating Compound, S. Heimann, New York, 547,120. Filed Feb. 28, 1895.
An insulating compound, composed of pulverized asbestos, pulverized glass, rubber, rosin oil, mirbane oil, castor oil and dissolved celluloid in about the proportions given.

Dynamos and Motors:—

Armature for Electric Motors and Dynamo Electric Machines, H. Chitty, London, Eng., 546,996. Filed July 26, 1892.
The armature sections are divided into "groups" each containing one more or one less than the number of magnet poles and each section containing two distinct coils or conductors wound in opposite directions, the conductor being wound in one direction in one section then in the opposite direction in the next.
Rectifier for Electrical Currents, W. J Still, Toronto, Can., 547,048. Filed Dec. 24, 1894.
A rectifier which registers with the varying phases of the current in such a manner that the connection of the commutator with the brushes will be changed as to the alternations exactly on the zero-line of the cycle of undulations.
Rotary Field Motor, J. H. F. Görges, Berlin, Germany, 547,069. Filed Oct. 10, 1893
The combination with two ring members placed face to face and provided with pluriphase windings to produce a rotating magnetic field in the space between the ring members, of a rotating member situated in the space between said ring members adapted to be rotated by said field.
Electric Motor, A. E Boggs, Allegheny & J. J. Cleaver, Beltzhoover, Pa., 547,323. Filed Jan. 4, 1895.
The field magnets are cast integral with the car wheels.
Reciprocating Electric Engine, F. B. Rae, Detroit, Mich., 547,888. Filed May 31, 1892
Object of this invention is to produce a magnet the pull of which has an indefinitely long range and the speed and power of which can be controlled.

Lamps and Appurtenances:—

Hanger Board for Electric Arc Lamps, T. E. Adams, Cleveland, O., 547,106. Filed July 17, 1895.
The board is incombustible and the lamp is suspended independently of the conductors, together with other details.
Electric Arc Lamp, J. W. T. Olan, New York, 547,127. Filed Apl. 8, 1893.
Forms an arc between liquid electrodes within an exhausted gas-containing globe.
Mast Arm for Electric Lamps, J. I. Drake, Providence, R. I., 547,246. Filed Feb. 21, 1895.
Details of construction.
Incandescent Lamp, H Green, Hartford, Conn., 547,249. Filed Jan. 25, 1895.
Adapted to be operated for making and breaking the circuit without the aid of any operative appliances or circuit makers and breakers for this purpose.
Railroad Car Lamp, C. G. Smith, Brooklyn, N. Y., and A. French, New York, 547,300. Filed Aug. 11, 1894.
Details of a method for supporting railroad incandescent lamps.

Miscellaneous:—

Electric Vibrator Mechanism, F. J. Russell, New York, 547,084. Filed Apl. 15, 1895.
Relates to that class of electric vibrator mechanism in which the energized current is not interrupted during operation.
Self Playing Mechanism for Pianos or Organs, F. W. Hedgeland, Chicago, Ill., 547,071. Filed Feb. 23, 1894.
Electric Device for Controlling Actions of Musical Instruments, F. W. Hedgeland, Chicago, Ill., 547,072. Filed Feb. 23, 1894.
Details relating to a perforated strip which controls the electric impulses actuating the keys.
Electric Synchroniser for Clocks, H. S. Prentiss, Elizabeth, N. J., 547,358. Filed Aug. 10, 1892.
Portable Electric Drill, J. W. Jaimison, Vallejo, and J. M. Edmunds, Napa, Cal., 547,215. Filed Dec. 26, 1894.
Details of construction.

Railways and Appliances:—

Contact for Electrically Propelled Vehicles, E. B. W. Reichel, Charlottenburg, Germany, 547,081. Filed April 4, 1894.
The combination with a horizontal arm extending transversely to the trolley conductor and adapted to make rubbing contact therewith, of a bar or strip of anti-friction metal mounted upon the face of said arm.
Electric Motor Truck, W. G. Gaither and W. R. Gaither, Chicago, Ill., 547,068. Filed Nov. 10, 1894.
The motor is arranged to be moved in and out of contact with grooved gears keyed to the axles.
Electric Railway Repair Wagon, A. Iske & A. Iske, Lancaster, Pa., 547,077. Filed Dec. 18, 1894.
The working platform is mounted on a lazy tongs arrangement, so as to be readily raised and lowered.
Trolley and Trolley Pole, W. L. Pepper, Philadelphia, Pa., 547,288. Filed Dec. 29, 1894.
The trolley wheel is supported on a lazy tongs device.
Electric Motor for Street Cars, W. Stine, Omaha, Neb., 547,302. Filed Jan. 11, 1895.
Arrangement embodying worm and gear driving.
Conduit Supply System for Electric Railways, G. Tolmie, Carbon, Wyoming, 547,304. Filed July 10, 1894.
The circuit closing contacts are placed within a collapsible case, closed by the current collecting device as it passes over it.
Device for Controlling Speed of Electric Cars, J. Brady, Brooklyn, N. Y., 547,369. Filed June 24, 1895.
Embodies a centrifugal governor which controls an arm sweeping over a rheostat controlling the motor and also a brake magnet; also operates a visual speed indicating device.

Switches, Cut-Outs, etc.:—

Electrical Junction Box, W. S. Johnson, Milwaukee, Wis., 547,078. Filed Jan. 21, 1895.
Details of construction.
Electric Switch, N. Marshall, Boston, Mass., 547,149. Filed June 8, 1895.
An improved snap switch.
Automatic Electric Switch, G. W. Russell, Jr. & A. V. Officer, Denver, Col. 547,290. Filed Mch. 18, 1895.
Invention consists in cutting the solenoids out of the circuit after they have been momentarily energized.

Telephones:—

Telephone, H. T Johnson, Elizabeth, N. J., 547,265. Filed June 18, 1894.
Consists in a special arrangement of circuits wherein the telephone and call-bell are placed in parallel one with the other and each with its branch normally closed.
Telephone Exchange System, E. E. Yaxley & J. H. Riley, Chicago, Ill., 547,388. Filed Jan. 14, 1895.
A system of telephone circuits, either metallic or ground, in which the telephone or "talking" circuit and the signal or "calling" circuit are arranged as substantially independent circuits, but with a common return, and in which a direct and metallic talking circuit of a minimum resistance is provided.
Telephone Toll Apparatus, G K. Thompson, Malden, Mass., 547,405. Filed May 13, 1895.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

A. K. WARREN & CO.

The old business of Warren & Lozier is now being continued under excellent auspices by Mr. A. K. Warren, the name of the new concern being A. K. Warren & Co. No change has been made in the location of the business, the headquarters being, as before, at 465 Greenwich street. It would surprise many of our readers to learn how large an industry has been built up through the energy and skill of both Mr. Lozier and Mr. Warren, and how active and thriving the concern is, in spite of dull times. As a matter of fact, the repair trade was never brisker than to-day, owing perhaps to the fact that when a spirit of economy prevails, people will very often patch up an old machine very extensively rather than indulge in the extravagance of new. The Warren Co. repairs dynamo machinery from a ½ H. P. fan motor up to a 250 K. W. generator, and it is remarkable how many men are required in such a shop. Nor is this extensive repair work all, for the Company has a special line of commutators which it builds, and it also makes large quantities of copper brushes. Of its special armature rewinding, customers have said that they prefer the rewound ones to those that come new, which would indicate great care and thoroughness.

A. K. Warren & Co. has a distinct branch in its trade in buying and selling second hand machinery, and issues a useful monthly bulletin to cover the work in this department. The attention of the concern is not restricted to electrical apparatus, but it has also much to do with engines and general machinery. Mr. Warren is a practical highly trained engineer and not less an expert machinist, who has supplemented the theory of the schools with the practical toil of the bench. He enjoys the help of a large staff of assistants and foremen, and carries into all the work the principle of close supervision and personal responsibility.

ENGINEERS AS INTERNATIONAL YACHTSMEN.

Our readers will be interested to know that the "Ethelwynn" which won the victory over the British yacht "Spruce IV," in the recent international race for half-raters, was sailed by Mr. Bert C. Ball, with his brother Mr. Fred. O. Ball at the sheet. Both these young men are sons of Mr. F. H. Ball of the Ball & Wood Engine Co., the former being employed in the shops of the company which the younger brother will also enter after the completion of his studies at the Stevens Institute of Technology. Mr. C. J. Field, the electrical engineer, is the owner of the "Ethelwynn."

THE MORRIS & PERRY CO.

The above concern has been established, with headquarters at 10 East Sixteenth street, New York, to deal in electrical supplies, undertake electrical construction, and handle all kinds of electrical wiring and repairs. Mr. R. W. Morris, has been connected with the Sawyer-Man Electric Co. since shortly after it was started, and for the past few years has had charge of the sales department; while his associate, Mr. Perry, has had six years' experience in electrical manufacturing and construction. The company is about to incorporate under the name now taken, with sufficient capital for the requirements of its business.

ON SNAKE HILL.

Jersey City's famous Snake-Hill Boulevard, will shortly be illuminated throughout the entire length by the Standard arc system of electric lighting, as 320 Standard arc lamps are being placed in position.

"BEAR IN MIND."

A huge figure of a bear stamped out of cardboard, with the above legend, is the way in which the Forest City Electric Co. of Cleveland, calls special attention to its "Roll drop" bars; and it suggests that when commutators need refilling the best way to do so is to fall back on the product of the Forest City Works. Under a flap are given a few points as to the quality of these bars, which are readily available when wanted, being carried in stock in Cleveland and New York. The bear has a string to it and will be a neat ornament for every bullish office.

BIDDLE CATALOGUE OF WESTON INSTRUMENTS.

Mr. James G. Biddle, Philadelphia, Sales Agent for the Weston Electrical Instrument Company, has just issued a very complete and convenient illustrated price list of volmeters, ammeters and wattmeters.

As Weston instruments need no special description, the pamphlet briefly mentions them by number, range, price and code word so that all particulars which a buyer needs are presented, without "extras." Another important feature is a short chapter devoted to methods of measuring resistance with the Weston Voltmeter and Milli-voltmeter. Diagrams and formulas are given that will prove most valuable to the station manager and engineer, explaining how insulation and other kinds of resistance are determined by methods much simpler and better than those which prevailed a few years back. Interested parties should write immediately to Mr. Biddle at 522 Drexel Building, Philadelphia, to secure this catalogue—No. 115.

BALL ENGINE CO.

The Ball Engine Co., of Erie, Pa., have issued a very neat, dainty and pithy little brochure which consists practically in a set of illustrations of their various types of direct connected and belted engines. It is, in short, an admirable compendium of what one may call the evolution of engine and dynamo separately and of their evolution together. The inter-relations can be well studied in this little book.

A 14-MILE G. E. TRANSMISSION AT BARTON, VT.

The village of Barton, Vt., is putting in a 14-mile 5,000 volt transmission plant, using the General Electric monocyclic system, the local company being known as the Barton Electric Light & Power Association. The power house will be located at Charleston, Vt., and the current will be sent to Barton over No. 4 B & S. copper mains to a sub-station in the village, where the step down transformers will be placed. The street mains will be No. 0000 B. & S. copper, and will be run on the 3-wire system. Mr. Ernest Gonzenbach, E. E., is the superintendent of construction.

CHLORIDE ACCUMULATORS FOR HOUSE LIGHTING.

The Electric Storage Battery Company has closed a contract for a storage battery of Chloride accumulators to be installed as an auxiliary to the electric lighting plant in the summer home of Mr. W. Luttgen, Linden, New Jersey. Also for a battery installation for the residence of Mr. John J. Dewey, Queche, Vermont; also a battery to be operated in connection with isolated lighting plant of Lewis Jones, Overbrook, Pa.

BUYERS' HINTS.

ELECTRIC HEATERS for various uses are offered by the Electric Appliance Co.

DIRECT-COUPLED MONOCYCLICS is the G. E.'s theme in their "ad" this week.

"THE DEADLY PARALLEL" is the topic of the Westinghouse Co.'s card in this issue.

THE SETH THOMAS CLOCK Co. announce that they make a specialty of work for electrical companies.

IF YOU ARE GOING TO MONTREAL, you will find the D. & H. a very direct route with excellent service.

THE BORDEN & SELLECK Co. are advertising their conveyors this week. Practice has shown their apparatus to be most satisfactory and economical.

ATTENTION is called by the Central Electric Co., to their very large and complete stock of telegraph instruments for all classes of work.

COPE AND COMPANY say their system for wiring conduits is unexcelled. They show a record of over 1,200 miles of duct last year.

NEW YORK NOTES.

CORTLAND, N. Y.—At a recent meeting of the Cortland Electric Forging Company, the capital stock was increased to $100,000, and the following directors have been elected since the company re-organized: Messrs. D. F. Wallace, Curtis L. Kinney, Benjamin F. Taylor, Enos E. Mellon and J. Hub Wallace.

"THE AMERICAN ENGINEER," of which Col. M. N. Forney is editor, is to be published bi-weekly after November 1, and will appear every other Thursday. The price will be 10 cents a copy. More frequent publication is desirable for papers of such dignity, influence and usefulness, and the readers of that excellent engineering journal are to be congratulated on the change made.

WESTERN NOTES.

MR. H. A. WAGNER, General Manager of the Wagner Electric Mfg. Co., St. Louis, was a Chicago visitor last week.

MR. J. H. RHOTEHAMEL, President of the Columbia Incandescent Lamp Co., St. Louis, has also made a trip to Chicago recently.

MR. C. W. WOODWARD, Western Manager of the Electric Storage Battery Co., of Philadelphia, has secured the services of Mr. Wm. Hood, who is well known among the electrical fraternity in the West, and particularly on account of his long connection with the Accumulator Co.

THE JENNY ELECTRIC MOTOR Co., of Indianapolis, Ind., have now been running their new plant about two months; and although they have greater capacity they are working night and day with double shift. They now have it in contemplation to further increase their plant.

THE SUNBEAM INCANDESCENT LAMP COMPANY, of Chicago, has added to its strength by securing the active interest of H. B. Vanzwoll, formerly connected with the wholesale hardware firm of Hibbard, Spencer, Bartlett & Co. Mr. Vanzwoll has become its Secretary, and F. S. Terry, who has formerly held that office, has been made Vice-President.

MR. THOS. G. GRIER, of Grier Bros., Western Managers of the Bryant Electric Co., has been confined to his home for some time past with a dangerous attack of bilious fever. His many friends will be glad to hear that he is now out of danger, although it will probably be some two months before he will be able to attend to business again.

THE C. E. WOODS Co. are now settled in their elegant new offices 1315, 1316 The Monadnock, Chicago, where they have considerably more room than in their old quarters at 1616, the same building. The rapidly increasing business of this company made the change absolutely necessary, particularly as they were very confined for room in their drafting department, and the space they now have for that purpose is everything that can be desired.

THE ELECTRIC APPLIANCE COMPANY has something interesting to say about a new system of interior lighting, by means of the inverted Upton arc lamp, by which the light is thrown against a white ceiling, and thus diffused more evenly than is possible in any other way. This arrangement entirely does away with sharp shadows and darkness in spots, and gives the nearest approach to sunlight that has yet been secured. It is particularly adapted to large stores, mills and factories, and promises to come into quite general use.

ROSS, WILSON & Co.—The business world is full of changes, the latest being the formation of the engineering firm of Ross, Wilson & Co., 418 The Rookery, Chicago. Mr. Wilson is "that jolly Scotchman" who has sold Babcock & Wilcox boilers in the northwest for eight years past, while W. A. Ross has been his antagonist in advocating the merits of the Campbell & Zell boiler. Now these two successful salesmen have joined hands and will push the sale of the Zell water-tube boiler, with an irresistible stock of conglomerated arguments.

NEW ENGLAND NOTES.

THE BRYANT ELECTRIC Co., of Bridgeport, Conn., have just issued a new catalogue of their numerous well-known electric specialties. It is considerably larger than any they have previously issued, and contains a number of novelties, brought out during the past year. The catalogue is well illustrated with cuts of the Bryant switches, cut-outs, plugs, receptacles, sockets, etc., for which the Bryant Co. have established a wide and favorable reputation, and should prove valuable to all contracting electrical engineers and supply houses.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.
Vol. XX. OCTOBER 16, 1895. No. 389.

ELECTRIC TRANSPORTATION DEPARTMENT.

ELECTRIC RAILWAYS AND THE ELECTRIC LAUNCH SEASON OF 1895.

A Train Load of Launches.

IT might have been expected after the extremely successful use made of electric launches, at the World's Fair in 1893, that they would have jumped into instant popularity. When we consider that 1,003,500 passengers were carried in a few months by the fleet of fifty boats with a total mileage of 202,700, it will be seen that the new means of short water travel was fairly well advertised; and the inference would be fair that a taste for such recreation would be carried away by many able to indulge it, or ready to embark on a new industry. As a matter of fact, the immediate inquiry for these boats was large, but the business prostration of 1894 was sufficiently severe to prevent any extensive investment, whether by individuals or by corporations. The result has, therefore, been a slow increase in the number of boats afloat; but the times are now rapidly improving, and there is every indication of a general resort to electrical navigation for purposes of business and pleasure.

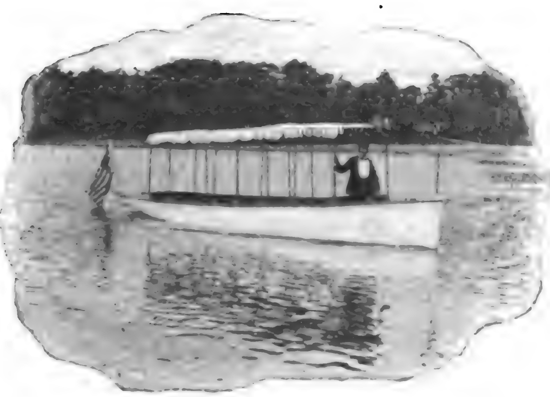
So far, the variety of private electric launches has not been large, and the tendency during 1894–5 has been to build large boats for wealthy people. Even with moderate means, it is reasonably easy to acquire a bicycle, but one has to think several times before buying a boat that costs a few hundred dollars at least, and that must have provision for charging. The small boats are liked and the facilities for charging become daily more numerous; but in the meantime it is the electric railway companies that are chiefly interested in the encouragement of this newer but allied art. A survey of the large amount of work done during the past year, brings out the fact that trolley roads are the best customers at present for electric launches and are beginning to find in them a remarkably good source of income and profit. Most roads are willing to haul a passenger in a car 10 miles for 5 cents, but when the current is put into a boat, it is easy to obtain two or three times the amount for half the distance, on the water, which has no expensive steel track to keep up. The average depreciation on boats and batteries is below that of an ordinary car, and the expenses of operation are strikingly small. A few instances of what is being done will be of interest at this time, when there is every promise that 1896 will be by far the best year that electrical navigation has seen in America.

ELECTRIC BOAT HOUSE AND CASINO, LAKEMONT PARK, ALTOONA & LOGAN VALLEY RAILWAY.

Considerable attention has been given to this work, on the Wisconsin River, in connection with the Milwaukee street railway system, from whose lines the boats take

ELECTRIC LAUNCH DOCK AND CHARGING STATION, JAMAICA POND, BOSTON.

current. Mr. Otto M. Rau, who is manager of the service, now has a fleet of five launches, and while he reports that owing to extremely cool weather the season as a whole was not as good as that of 1894, the results still prove it to be



TYPE OF LAUNCH IN SERVICE, LUDLOW LAGOON AND JAMAICA POND.

"a very profitable investment." During the summer, the four launches kept in commission carried 14,000 passengers, at 20 cents the round trip of 5 or 6 miles. The launches ran a total of 1750 trips at a total cost of 80 cents per trip, including current, wages of two men as pilot and guard, and maintainence, showing a decided reduction against last year, when it cost $1.50 per trip. The company own three small steamers, remains of a pre-existing service, but is of opinion that if it entirely abandoned the steamers and replaced them by launches, it could handle the traffic much more satisfactorily and reduce operating expenses materially. In short, Mr. Rau says: "I am satisfied that for short passenger service on lakes and rivers, the electric launch will, as soon as confidence is put in it, displace the steam craft entirely." Each boat is 30 feet long and carries 35 passengers.

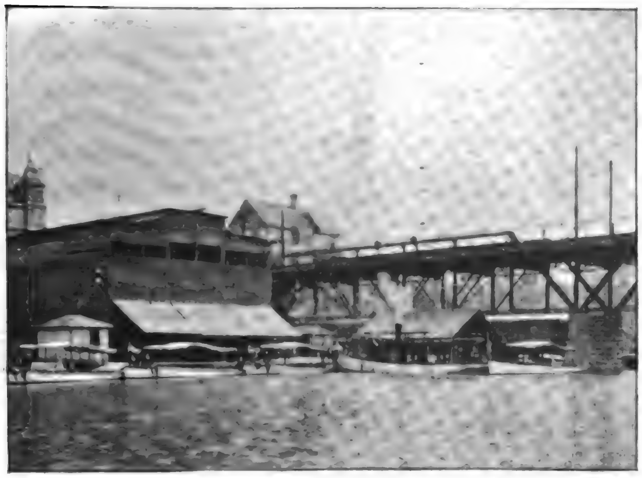
Another of the older fleets is that of five launches at South Park, Chicago, which is composed of World's Fair boats. It is operated for passenger and excursion service under the control of the South Park Commissioners and has now seen two seasons.

At Ludlow Lagoon Park, Ludlow, Ky.,—one of the suburbs of Cincinnati,—four launches have been installed and in operation since last spring as a feature and attraction at this resort, where the trolley cars from Cincinnati set down a good many visitors. According to the manager of the Park: "They have been a good advertisement and one of the best paying investments on the grounds." The batteries are charged with current from the trolley lines. Each boat is fitted with 66 batteries charged in series with current of 15 to 20 amperes and about 145 volts per boat; three boats in series taking 435 volts off the 500 volt trolley circuit.

Under the direction of the Park Commissioners of Boston, two launches have been put on Jamaica Pond, in connection with the Boston Public Park boat service. Each boat is fitted with 52 batteries, 200 ampere hours each; and charged from the trolley lines of the West End Railway. The charging current is taken from underground mains, and the surplus E. M. F. is taken up by a water resistance. This resistance consists of a barrel of water and an iron plate at the bottom connected with the ground wire of the railway system. The other wire connected with a window weight is let down into the water to the required depth, at which the incoming charging current is about 18 amperes. Our cut shows one of the boats at the dock, receiving passengers. The barrel of water is seen outside the small house at the left of the picture. The Boston boats, à la "Nancy Bell," have only one man each as the entire crew, who fills all parts.

ALTOONA ELECTRIC LAUNCH "UNDINE."

Lakemont Park, Altoona, Pa., is an artificial but pretty sheet of water, made as a special attraction in the spring



DEPOT OF MILWAUKEE ELECTRIC FLEET OF FIVE LAUNCHES.

of 1894 by the Altoona & Logan Valley Electric Railway Co.; and one of the first and most successful "features" was the electric launch "Undine," which, when put afloat, was duly christened on the bows with a bottle of champagne. She is charged from the trolley circuits. The batteries are charged in the forenoon and also between trips. The launch makes 28 round trips on a 3-hour charge, each trip lasting 10 minutes. The surplus E. M. F. is taken up by means of a German silver resistance coil, the boat requiring about 58 volts and 18 amperes. This does not appear to be an economical method, but serves the purpose and satisfies the company, who find the boat to be a great success financially.

Lake Saltonstall, near New Haven, Conn., was equipped

BOAT CHARGING IN LAKEMONT PARK, ALTOONA.

last season with a launch which has again been in operation this year. The boat is charged with current from the trolley line, taking 18 amperes; and has 64 batteries. The launch has met each trolley car on its arrival from New Haven at the lake, and has been very popular with the summer visitors.

Mention has already been made of the fact that a fleet of 6 launches has been put on the large ornamental lake at the Atlanta Exposition, where a separate charging house has been fitted up for their special use. The service is very much on the lines of that at the World's Fair, the journey being broken by stoppages at five stations en route; while at night the launches serve as a good vantage ground from which to see the electric fountain, &c., and can be hired by private excursion parties. The little cut at the beginning of this article shows the train load of six launches, en route for Atlanta from New York.

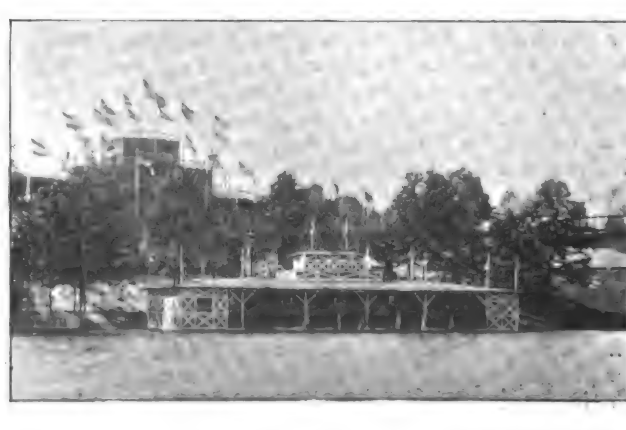
The launches were shipped on extra long cars of the long flat type—known as "gondola" but in this case dubbed "launch"—and banked two together, on each car, one above the other. To ship in this manner, they were stripped so as to pass under the many railway bridges en route.They all reached Atlanta in perfect safety.

Each boat was fitted with 56 batteries of the Chloride accumulator type, 175 ampere hours each; and the charging is done from an85 volt constant potential circuit, fed by a generator in Machinery Hall, thrown on this service during the night but devoted to other work during the day. The current can, however, be used in day time if it proves necessary. Each boat requires 4 H. P., an average of less than 5 hours, for the day service of from 12 to 13 hours, from 9 a. m. until 10 p. m. The average charge is from 35 to 40 amperes. The boat-house is close to the most popular landing on the lake, and is visited by large and inquisitive crowds. The regular fee is 25 cents for a round trip lasting 25 minutes only, but on firework nights, the crush for seats in the launches has been so great it was raised to 50 cents. Even that did not relieve the pressure

LAUNCHING "ELECTRA," LAKE SALTONSTALL, NEW HAVEN, 1895.

and the launch fee for seeing the fireworks is now 75 cents, which is paid with alacrity.

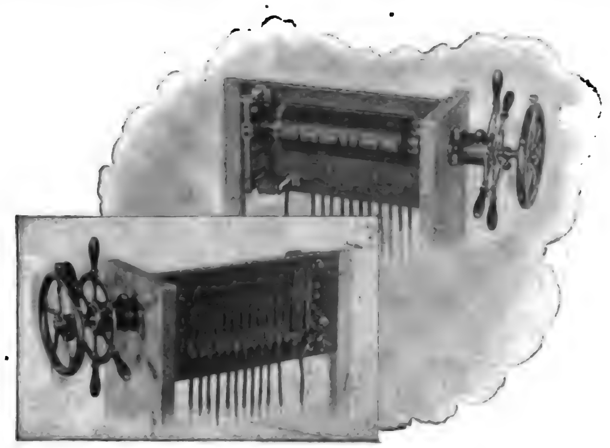
It is interesting to learn from Mr. J. C. Chamberlain, of the Electric Launch Co., this city, to whom we are indebted for much of the above information, that several trolley roads and parks are already making their plans for this work in 1896, one road estimating that it may need as many as 15 launches. Plans are also on foot for the equipment of the large sheet of water at City Point, Boston; Roger Williams Park, Providence; Prospect Park, Brooklyn, and Central Park, New York. It is also becoming a feature for hotels near bodies of water to equip with a launch, after the manner of Tampa, Fla., where during the past two winter seasons two of the boats were found extremely useful and popular. In such



THE ELECTRIC LAUNCH BOAT HOUSE, ATLANTA EXPOSITION.

places there is a good opportunity found for the smaller type of boat, of which several have been built by Mr. Chamberlain with success during the past three years.

The mechanism of the boats is steadily tending to simplicity and ease of manipulation; and a trolley company should experience no difficulty in entrusting a boat to any motorman who can run a loaded car through a crowded street. It should be borne in mind that no higher average of skill and intelligence is required on a launch than on a car and that wages cost no more, while the work is much more agreeable to the men and is often looked



CONTROLLER AND STEERING WHEEL.

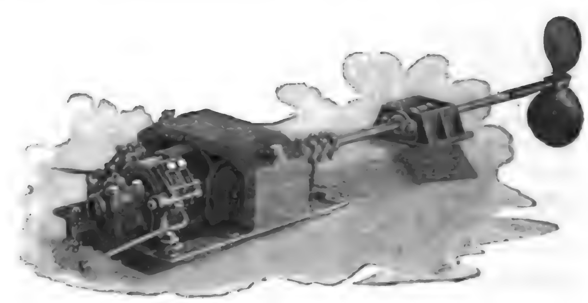
upon by them in the light of promotion. A storage battery launch does not require genius for its operation, but simple care and faithful attendance, receiving which the cost for current makes no appreciable difference in the outlay for fuel at the road's power house. We show here one or two cuts illustrative of the motors, etc., that Mr. Chamberlain has been equipping the launches with during this year. The ordinary launch

MOTOR FOR SMALL PRIVATE BOATS.

motor is of the familiar type, flat and directly connected by split coupling to the propeller shaft and placed beneath the flooring in a lead lined compartment. It is bolted to longitudinal bearers and is placed under removable trap doors. It has ball bearing thrusts and all the bearings are self-lubricating. For smaller boats a smaller motor of circular field frame is used, with brackets on either side, which can be secured to any suitable support in the hull. One armature end is shaped into a coupling with which the propeller shaft connects directly, both noise and vibration being thus minimized. The shaft is of Tobin bronze, with a stuffing box that can be attached to the stern post of a boat and fitted with a suitable propeller wheel. There is a small and handy regulating and reversing switch. In the larger boats, the controller and steering wheel is a compact piece of apparatus, as here shown. It is fitted under the forward deck and operated by means of a shaft that extends through the bulkhead and the steering wheel bearing. It is not unlike a street car controller placed lengthwise, and has sliding brush contacts to which the leading wires from the groups of batteries, and from the motor, are connected. The controller wheel is of less diameter than the steering wheel and directly in front of it. By moving the wheel to the right, over its successive stops, the grouping of the batteries is effected which gives the required speed and determines the current consumption. The controller will reverse the motor, but there is a separate reversing switch. Under the forward seat also there is a special combination charging and motor switch, so constructed that the lever arm can close only either the motor circuit or the charging circuit at will. The switch is fitted with binding posts or plug contacts to which the charging cable can be readily attached, as seen in the cut of the launch being charged on the Altoona lake.

Hull of Boat Stripped, Showing Motors and Batteries.

An interesting modification in the build of the 1896 type of electric launch has been introduced by Mr. Chamberlain in fitting a light wooden roof with storm curtains to the iron awning posts, and in providing the



MOTOR FOR "OMNIBUS" LAUNCHES.

"omnibus" boats with a strong flat iron band six inches above the combing, which serves as a back rest for the passengers. The interior mechanism remains the same. The first of these boats has been equipped and floated already, and has proved very successful in her trips on the Harlem River. As it is evident that the "omnibus" boats will prove a large factor in the

THE 1896 "OMNIBUS" TYPE OF ELECTRIC LAUNCH ON THE HARLEM RIVER.

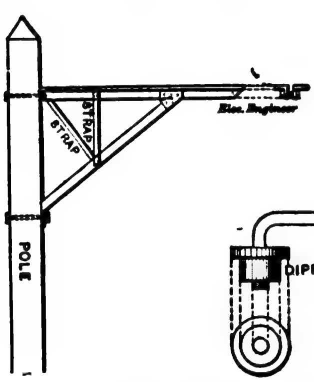
business of the near future, special attention has been paid to qualities adapting them for rough work which are hardly necessary in the more ornamental private boats.

THE MONTREAL PARK AND ISLAND RAILWAY.

It may be interesting to American engineers to compare the construction of a Canadian electric railway with one of their own, and to note the manner in which such serious drawbacks as a severe winter climate and heavy import duties are met and overcome. While the growing cities and towns of the Dominion are nearly all provided with a wealth of undeveloped water power, besides many other valuable resources, the two above-named hindrances prevent the immediate success of enterprises that might otherwise be made productive of much public and private benefit. It is safe to say, however, that in every instance where interurban electric railways have been put into operation in the Dominion, the experience of similar lines in the United States has been repeated as regards the rapid development of the surrounding country.

The Montreal Park and Island Railway Company, which owns franchises covering almost the entire island of Montreal, excepting the city proper in which the Montreal Street Railway operates a splendid electric system, began in 1893 the construction of an electric line across the island to the popular resort of Sault au Recollet, or, as it is more commonly called by the English population, "Back River." The line was finished in December, 1893, and by great efforts kept open the entire winter, losing only a single day's traffic from the heavy snow storms. In the spring of 1894 another line around the famous Mt. Royal to Cote des Neiges was built and opened for traffic in the following July. Both lines soon became famous as pleasure routes. On pleasant holidays and Sundays the Company's cars have literally been taken by storm by the crowds eager to forsake the city streets for a country outing along the banks of the Sault or among the beautiful nooks in the cemeteries of Cote des Neiges.

During the present season the Cote des Neiges line has been continued around the famous Mt. Royal, through



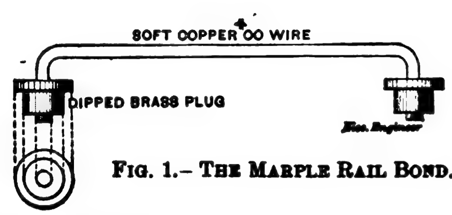


Fig. 1.– The Marple Rail Bond.

Fig. 2.—Single Bracket Construction.

Notre Dame de Grace and Westmount and connecting with the tracks of the Montreal Street Railway Company so as to give a double tracked belt route through the city of Montreal, over ten miles around. At an early date it is also expected to run a spur line to Lachine, a distance of ten miles from Montreal.

THE TRACK.

For the sake of avoiding the heavy snow drifts in winter, as well as to obtain high speeds across the country, the lines have been built, wherever possible, on a road-bed, elevated from one to two feet above the level of the ground, even where the track passes along the side of a road. It has been the practice to avoid country roads completely on account of the snow.

Crushed rock ballast has been employed almost entirely, giving a splendid road-bed over which ordinary four-wheeled cars ride smoothly at a speed of twenty-five miles an hour with almost no dust.

A fifty-six pound T-rail is used throughout, with spring switch turnouts on all single track lines. The rails are bonded with one No. 0 copper wire. A nine-sixteenths inch channel pin was used with fair success at first, but later an improvement was made in the use of a brass bonding plug, soldered to each end of the bond wire. This device, shown in Fig. 1, has proved a complete success, and is the invention of Mr. L. E. Marple, the electrical engineer and superintendent of the road. It consists of a cast brass stud $\frac{9}{16}$" diameter by $\frac{5}{8}$" long, bored lengthwise to take loosely a No. 00 soft copper wire. At one end of the stud is a shoulder or flange $\frac{7}{8}$" diameter by $\frac{1}{4}$" thickness. After one of these bonding plugs has been slipped over each end of a bond wire, both ends of the wire are dipped into solder, and the bond is complete. In driving the

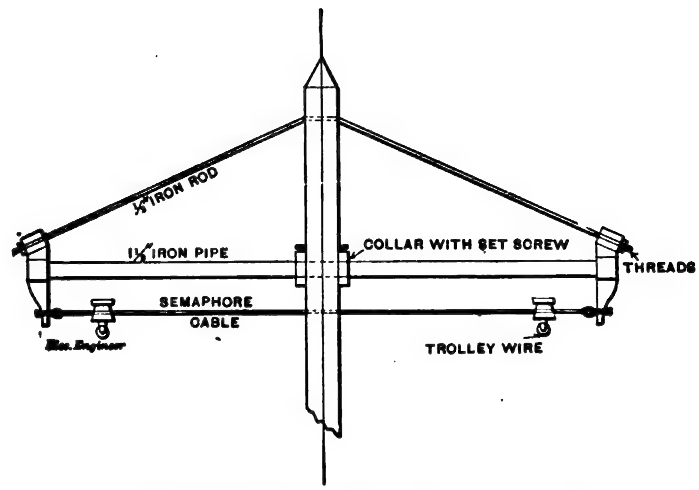


Fig. 3.—Double Bracket Construction.

plugs into the rail holes, a special hammer is used, having a grooved head which admits the bond wire, yet covers completely the flange of the bonding plug, thus making a perfect mechanical job. It is claimed that the coating of solder on the outer surface of the plug makes not only a better electrical connection with the rails, but a far better mechanical fit in the hole.

At every fifth joint the rails are also cross-bonded.

OVERHEAD CONSTRUCTION.

In building the overhead construction of the Montreal Park & Island Railway Company the chief aim has been to erect stable and permanent work which could be relied upon to withstand the severe climatic strains imposed upon it.

For trolley-poles tamarack was at first used on account of its strength, but it was subsequently proved that solid cedar poles with nine inch tops, such as can be procured dressed in Montreal for $2 each, were well able to withstand all strains, and possessed a far longer life than the tamarack.

Span construction is used only where the tracks pass in the middle of streets; in all other places, brackets are used. These brackets were made for the Company by local firms, at very low figures.

For single brackets, Fig. 2, 1$\frac{5}{8}$" angle iron is used, with flanges riveted on the ends for bolting through the cedar-poles. They are very rigid and cost only about $2.10 each, complete.

The double bracket, Fig. 3, is also the design of Mr. Marple. It consists of a solid piece of 1$\frac{1}{2}$" iron pipe 13 feet long thrust half its length through the cedar pole at a height of 20'-6" from the track. An iron casting slips over each end and is held in place by a set-screw. Through a hole in the upper part of the casting slips a $\frac{1}{2}$" iron rod, fitted with an adjustable nut at each end. This rod passes up through the pole at a height of 3'-6" above the pipe and is bent down and slipped similarly through the casting at the other end, thus forming an absolutely rigid support.

At the lower end of the casting is another hole which takes an adjustable screw-eye, through the eye of which is fastened a piece of $\frac{5}{16}$" steel semaphore cable which also passes through the pole and is similarly fitted at the other end of the bracket.

It is understood that these brackets are manufactured in Montreal for $2.30 each.

The trolley wire is the usual No. 0 hard-drawn copper used in the United States, and is made by the Dominion Wire Manufacturing Co., which has a very extensive plant just outside the city limits. The overhead parts are of the "West-End" type, the brass work of which is made in Montreal, while the insulators are furnished by the H. W. Johns Co., the Fiberite Co. and Albert & J. M. Anderson, through their Canadian agency, the Ingersoll Rock Drill Co., of Montreal. Most of the feeders are put up without insulation, thus effecting quite a saving in cost.

POWER STATION AND CAR BARN.

Power is furnished from a temporary plant at the Montreal Exposition Grounds. The plant consists of one 200 K. W. generator, belted to a 22" x 48" Cooper-Corliss engine, made by C. & G. Cooper of Mt. Vernon, O., and one 100 K. W. generator belted to a 16" x 42" Cowan-Corliss. The generators were both made by the Royal Electric Company of Montreal.

A temporary car-barn and repair shop is situated adjacent to the power-station, and is heated therefrom by exhaust steam.

The rolling stock consists of ten closed, and four open motor cars, with seven trailers. The bodies are made by the J. G. Brill Co., Larivière of Montreal, and Crossen of Coburg, Ont., and are mounted on Brill maximum traction and Peckham trucks, and also a modified Brill truck built by the Canada Switch Co., of Montreal. The equipment is mostly Westinghouse, but there are several Royal Electric Co. motors.

OPERATION.

Within the city of Montreal proper an exclusive franchise is held by the Montreal Street Railway Company, as stated above, but through an advantageous contract the Park and Island Company is enabled to run its cars over the city lines.

By the terms of this contract the Park and Island Company may run all its through passenger cars into the

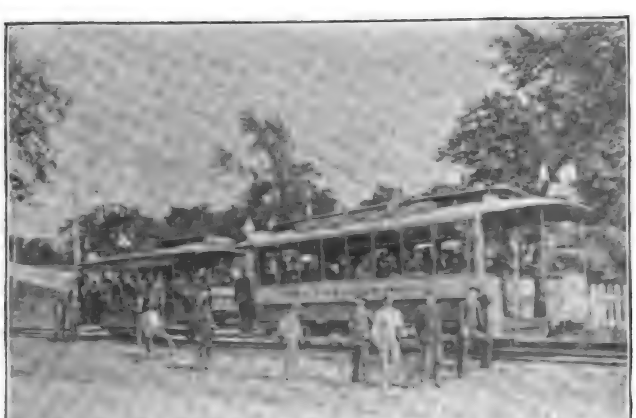


FIG. 5.—TWO SPECIALS ON THE OUTREMONT DIVISION, MONTREAL.

heart of the city, and may collect for itself the value of a full city fare from all through inward passengers. It may also lease at 5 per cent., for a period of 25 years, from the Montreal Street Railway Company, one completely equipped motor car, equal to a Brill No. 2 palace car in value, for every two miles of track constructed, but it must maintain all such equipment at its own expense, and at the expiration of the lease, return the cars in perfect order. In return the Montreal Street Railway Company mans and operates all cars while within the city, and collects for itself a city fare from all except through inward passengers. The arrangement is an admirable one for

FIG. 4.—PELOQUIN'S STATION, BACK RIVER.

convenience in issuing tickets, and Suburban Montreal has already grown wonderfully along the lines of the Park and Island Railway.

TELEPHONE DISPATCHING.

Metallic telephone circuits, in which the wires "twist" spirally so as to avoid all induction, have been strung on the trolley poles beside all the lines, and are also connected with the power-house and shops. There are some fifteen stations, situated at convenient sidings, and other points, and at the dispatching office at Mile End an operator is continually on duty, controlling every movement of the cars with absolute precision. The system works most admirably, and besides enabling the Superintendent to provide proper car accommodations most economically for varying crowds, without danger of delays or false crossings, there is always a useful record kept in the day's running sheet. Especially during the difficult winter traffic is this telephone system found of advantage, and the company now feels it could hardly operate without it.

The Manager of the Company is Mr. Henry Holgate, late engineer of the Royal Electric Company of Montreal.

GAS ENGINES AND THE NEW YORK ELEVATED.

The announcement recently made in the daily press that Mr. Westinghouse had recommended a new type of gas engine, manufactured by the Fuel Gas & Manufacturing Co., to drive the dynamos for the electric central stations which are contemplated in connection with the electrical equipment of the "L" road, seems to have aroused considerable interest. It may therefore be well to call the attention of our readers to the fact that the new type of gas engine referred to by Mr. Westinghouse was fully illustrated and described in THE ELECTRICAL ENGINEER of June 28, 1893, in an article entitled "The Pittsburg Gas Engine." The engine is the design by Mr. Albert Schmid, and ought to add much to economy in fuel as compared with most steam operated stations.

A 7000 PER CENT. TROLLEY FRANCHISE.

Seventy dollars for every $1 earned was offered New York City last week by bidders for a suburban trolley franchise. An injunction against further tomfoolery has been secured by a company which dropped out after offering 3 per cent. of gross receipts.

ROUNDABOUT NOTES IN ELECTRICAL EUROPE.—V.

BY

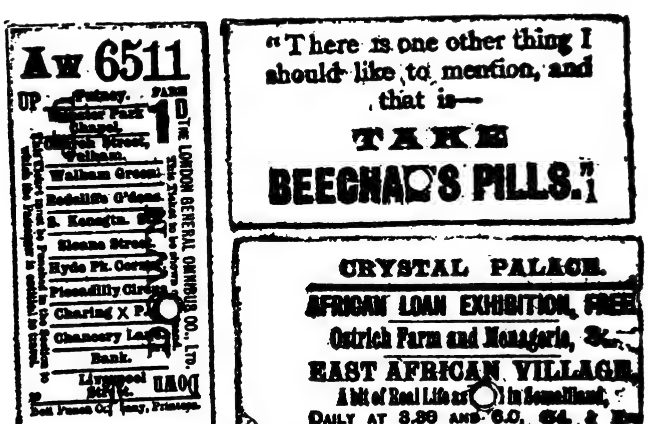
LONDON.

WHO can accurately forecast the future of electric traction in this mighty metropolis in which all nations are represented?

As one observes the thousands of 'busses, hansoms, and four wheelers which pass over certain thoroughfares every day, it requires a bold flight of the imagination to believe that the days for these vehicles are numbered. Yet, if the signs of the times be true, it will not be many years ere the motor car will be found in place of the 'bus. It does seem problematical, but not impossible, when one recalls the evolution of the railway motor in America.

An absolutely accurate census of the army of conveyances which handle passenger traffic is difficult to obtain. The number of licenses issued gives an idea, but even this is not final, as so many changes are occurring.

Perched on the steps of the Mansion House or at Charing Cross, the observer stands dazed at the congestion of traffic. 'Busses and cabs seem locked in apparently inextricable confusion. Accidents and fatalities seem unavoidable. They often do occur and some place the estimate at one death per diem due to maiming by wheels. This however may prove too extravagant. Consider the millions of travelers and, even if this estimate were not too high, the death ratio would be very small. The London 'bus since Dickens' days has not materially changed. It is a large, lumbering affair, devoid of beauty, and would merit scant attention here were it not for the very important part it plays in metropolitan life. As one watches the surging masses whose only means of ingress and egress between home and the "city" is the 'bus, it is easily seen what an important factor in every day life it is. We could not get a good photograph. The 'bus doesn't stay long enough in a given spot to fall a victim to the camera. It is queer looking and seems top-heavy. It always has more seats on top than inside, and the top is generally full.



FAC SIMILES OF SOME LONDON "BUS" TICKETS.

There is no protection against rain except a stationary tarpaulin which the passenger pulls over his knees and then defies the elements.

The driver is strapped in. He is perched high above the horses and almost over their flanks. It wouldn't take much to dislodge him but for the strap. He handles the two horses with ease, is a good whip and has a foot brake available. He has a quick eye and manages to avoid striking lamp posts and running over the urchins who, brush and pan in hand, dodge under horses and keep the dicky birds from getting a hot breakfast off the asphalt pavements of the roadway. The 'bus generally has painted on its sides the name of the secretary and manager. This innovation would hardly be appreciated in America. The exterior also has painted on it some six to twenty different places where the 'bus stops. These are kaleidoscopic if the 'bus is moving and can hardly be read. Hence the 'bus of each line is painted a distinctive color and on some a flag flies from a short pole. Advertising is done on boards at the side, on the roof. These act as a protection and keep passengers' limbs obscured. There is no inside advertising as a rule. Some of the ads. are unique, such as "Bryant & May's Matches. Patronize Home Industries. Support British Labour." A silent appeal to the patriot. Perhaps the most curious of all the ads. is one reading (after giving name and address) "Hats ironed and blocked. Teeth scaled and Corns cut. Buttons sewn on. Parcels received. Writing accomodation." Truly 'tis hard to beat this for surprising frankness and originality.

The 'bus fares are low and range from a half penny (1 c.) to five pence (10 c.) which cheap fares undoubtedly have led to the enormous traffic. The tickets are on the order of those illustrated and the back is used for advertising "Cockle's Pills" and other remedies. There is but one class. Everyone from navvy to banker rides "first."

This then is the competition the electric car must face. There are tram cars (double deckers) running in London, but they are not such a foe as the 'bus and would soon be converted into electric cars, if electricity were adopted. A start has been made in electric traction but it is not in the direction the projectors of the City and South London Electric Railway (the pioneer road) preferred. They had to be contented with an underground road leading away from the city. Near the monument at King's Cross, one enters the depot and either by a spiral staircase or hydraulic lift reaches the platform, considerably underground. These lifts are commodious and will easily carry fifty passengers at one haul. There are two in service at each station. This electric road has been so often referred to since the Prince of Wales declared it open for business, that no detailed account of it is needed here. While it greatly helps solving the problem of carrying a portion of London's teeming crowd, the road can not be the favorite it would be were it not for its foul odors and dingy cars. Immediately after leaving the city terminus, the trains take a sharp winding grade and in a few minutes have run under the River Thames. The line is a short one. One source of revenue is the sale of tickets for viewing the Company's locomotives and power plant. The speed is good and there are two distinct tunnels. Better time is possible than with a single tunnel, and more numerous trains can be run. The cars (or carriages) are adapted to the shape of the tunnel and have rounded roofs. Ostensibly lighted by electricity, in reality that can not be depended upon, on account of variation in load; and smoky lamps are kept burning at the same time, by whose dim light passengers help impair their sight. It is not remarkable that the City Council does not grant concessions for an overhead electric road, since all they have as an object lesson is this one, underground. Not that we wish to disparage it or overlook the pluck which led to, and the thoroughness with which the owners did, the work. All credit to them! But the contrast between this underground and some of the American overhead roads is so great that we would like the Councilmen to see one or two of our specimen overhead roads. It might change their views materially.

Apropos of electric roads, it is difficult to understand the hostility which the Council displays towards them. Only a short time since, this honorable body stopped the operating of an electric road by refusing to grant a franchise for only 180 yards at Hammersmith. The Board of Trade also must be reckoned with, and as its engineers are

chosen from the Royal Engineers, projectors of roads must toe the mark and conform to many absurdly strict requirements. They are opposed to 500 volts and favor nothing over 300. The specifications for some roads are prolix and make curious reading for those accustomed to American goaheaditiveness and abhorrence of multiplicity of details, seemingly needless ofttimes.

Despite the severe exactions and hostility to the cleanly electric roads, the Metropolitan (District) underground road is permitted to use coal for its locomotives. These locomotives are supposed to consume their own smoke, but it is a delusion. A ride over the line is an unpleasant experience. To say nothing of the soot and cinders, which one might endure, what shall be said of the abominable stenches? The smoke may be consumed but the sulphur is not and the mephitic atmosphere will cause everyone to avoid the line who can possibly do so. Electric motors would solve the difficulty and admit of comfort. They would do well here as the line has openings at frequent intervals through which fresh air would flow. This road was built at vast outlay and for a long time made bad losses. Of late it has paid small dividends. Were it not for the outlay entailed in electrifying it, most likely a long suffering public would demand the abolition of steam as a motive power.

Much complaint is made against the Manhattan Elevated R. R. in New York, but after the worst has been said, it is a vast improvement upon the London Underground. Both would be benefitted by conversion into electrics.

It is remarkable that very few passengers holding third class tickets attempt to enter first class compartments on the underground cars. The reason is simple. There is a very heavy fine for such offence, just as there is for a similar offence on steam cars. The London and Northwestern management, for example, puts placards upon its stations showing the names of offenders, character of the offence and the punishment. In some cases in addition to a fine of £20. stg. an imprisonment of 6 months follows. This has a salutary effect. If such system obtained in America very likely there would be fewer attempts to "knock down" fares, and the business of spotting and detective agencies, kept active at great expense, would fall off.

Earnest efforts are being made by far-sighted men to confer upon long-suffering Londoners the benefits of electricity. They are met with steady opposition. Hence instead of dwelling too intently upon the subject in dealing with the aforementioned Honorable Body they are confining their efforts particularly to important cities in other parts of the United Kingdom. This work will tell, and when such excellent roads as exist in Bristol have made their records and earned their dividends, London will follow in the wake of its younger and more enterprising sisters. May that day soon be ushered in.

TETE-A-TETE TROLLEY CARS.

Tete-a-Tete trolley cars, with sofa seats built for two, have been put on one of the Newark, N. J., suburban lines for the accommodation of excursion parties or young people who, growing weary of parlor matinees, desire to vary the monotony by riding in comparative seclusion over the electric lines of Essex County.

METROPOLITAN STORAGE BATTERY TRACTION COMPANY INCORPORATED.

The Metropolitan Electrical Development Company has filed articles of incorporation in the County Clerk's office in Jersey City. The capital is $1,000,000, and the incorporators are John R. Dos Passos, Conrad N. Jordan, Thomas D. Jordan, Charles N. Canda, and William L. Moore of New York, and Charles N. King of Jersey City. The company proposes to develop storage batteries for traction purposes. The company expects to run an experimental car on the St. Nicholas avenue road in this city on the 25th inst. Their Acme battery was the subject of an article in THE ELECTRICAL ENGINEER of Sept. 25.

AN EXHIBITION BOSTON TROLLEY MAIL CAR.

The second assistant postmaster-general will try an important experiment in Boston with a new mail car which is designed with particular reference to the receiving of mail direct from the hands of the collectors. As the mail car runs on schedule time, it will be at certain points along the route at stated times, and will be met at these points by the collectors, who will turn their mail into the mail car instead of into the several sub-stations.

This mail will be cancelled and assorted on the car, and left for immediate dispatch at the central office or some railway station. Although only one car is to be put into immediate operation, the West End company has built three cars on the new pattern, in the confidence that the scheme will be a success. The new car has straight sides, like a regular railway postoffice, which gives more floor space and more room for hanging pouches. It will have letter cases, assorting tables, pouch racks and storage racks, but its most important feature will be a cancelling machine.

The current which supplies motive power and light for the car will also supply the electric motor to run this cancelling machine, which will have a capacity of 40,000 cancellations per hour.

It was only after much labor that this application of the trolley current could be made. The trolley wires in the streets are disconnected or "sectioned" at short intervals, but as the breaks are only a few inches in length, the car is carried past them by its own momentum and they are not noticed. In running the cancelling machines it was found that these short breaks

THE NEW BOSTON ELECTRIC MAIL CAR.

presented an obstacle, which has finally been met by a special contrivance.

As the car is now equipped, letters can be cancelled just as fast as they can be fed to the machine. They can then be worked up for their respective routes, and it is expected that they can be delivered on an average an hour sooner than if they were taken to the sub-stations and handled in the old-fashioned way.

It is planned to have these letters marked by a letter or figure on the cancellation stamp so that each letter can be traced back to the locality from which it was sent. The stamp is here shown.

Heretofore the electric mail car has been principally a carrier of mail to the postoffice, but if the contemplated experiment is successful, it will bring the postoffice to the mail, wherever the mail may be.

DOWN THE FOX RIVER VALLEY.

One of the longest interurban electric railways yet built in the United States is expected to be in operation by the 1st of January, 1896. It will run from Oshkosh, Wis., to Kaukauna, through the cities of Neenah, Appleton and Menasha, a total distance of twenty-six miles. Members of the Central Wisconsin Electric Railway Company, which is to build the line, have made final arrangements for the work, which will be begun at once. Outside capitalists interested in the company are J. K. Tillotson and George H. Ketchum, of Toledo; M. B. Barr, of Cleveland, and C. E. Loss, of Chicago. Mr. Tillotson has just succeeded in floating bonds in New York to the amount of $1,000,000.

This road will take in the entire manufacturing district of the Fox River Valley, and eventually may be extended to Green Bay.

THE MONTREAL STREET RAILWAY SYSTEM.

THE meeting of the American Street Railway Association in Montreal will naturally draw the attention of the delegates to the electric railway system of the city; and with the courtesies invariably so lavishly extended to visiting associations in Montreal, there is little doubt that every opportunity will be afforded for

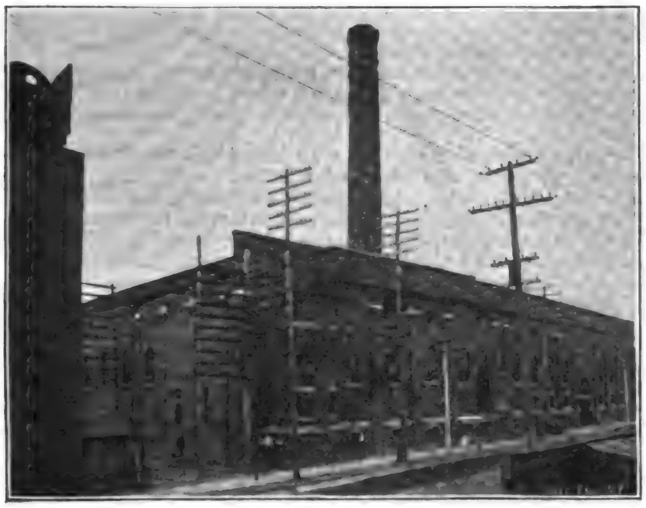


FIG. 1.—POWER HOUSE, MONTREAL STREET RAILWAY CO.

the inspection and study of Montreal's extended railway facilities. The roads of the city are marked particularly by their heavy grades, for out of ten routes there are only two which do not have grades exceeding five per cent., while grades between five and ten per cent. are frequent, and one actually reaches eleven per cent. for a short distance. Besides, the severity of Montreal's winter climate has made it necessary to adopt special methods of overhead construction, all of which will prove of interest and no doubt elicit comparative criticisms with our own methods.

It was in July, 1892, that the Montreal Street Railway Co. secured a thirty-year franchise to operate its system by electricity, and immediately began the conversion of all its horse roads to electricity. It is interesting to note that one of the conditions of the franchise gave the company the right to run sleighs drawn by horses, if it were found impossible to operate the cars in winter; but one winter's experience showed that the clause might have been omitted without detriment to the welfare of the company.

The power station is located on William St., near McCord St., convenient to the coal yards as well as to the Lachine Canal, whence water for condensing is obtained, and about a mile from the centre of the system. The building, shown in Fig. 1, is a one story and basement brick structure with foundations 12 ft. wide of large flat stones laid in cement. The building has a frontage of 209 ft. on William St. and a depth of 287 ft. at the main portion and is divided into two parts, one for the boilers and the other for the engines and dynamos.

The boiler room, Fig. 2, measures 107 ft. by 114 ft., and con-

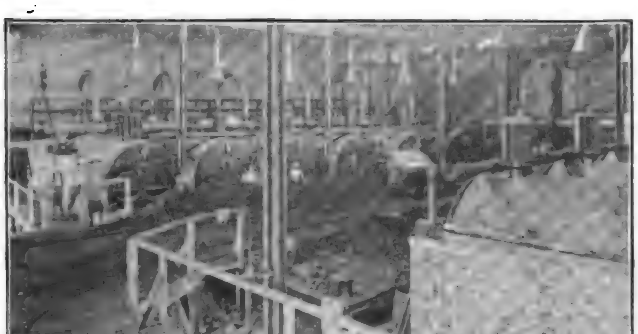


FIG. 2.—BOILER HOUSE, MONTREAL STREET RAILWAY CO.

tains twelve boilers of the double flue Lancashire type, made by Daniel Adamson, of Manchester, England, to which four more have lately been added. The boilers are arranged in two batteries, and the gases from each furnace pass through the flues of its boiler, then return under the boiler and go back along its sides to the main flue. Thence they pass at a temperature of about 450 degrees into a Green economizer, which heats the feed water to a temperature of from 260 to 300 degrees. By means of a by-pass the gases can be admitted directly into the chimney if desired. On the floor in front of each boiler is a door opening into a chute by which the ashes are conveyed to pits on the floor below. As this floor is level with the street, the ashes are easily removed in carts. A yard capable of storing 2,000 tons of coal is located next the boiler room and on a level with its floor.

The consumption of fuel per electrical horse power is very satisfactory. For the months of August, September, October and November of last year, the pounds of coal consumed per electrical horse power were as follows: 2.68, 2.94, 2.74 and 2.65, respectively.

The chimney, which is one of the highest in the city, has a height of 190 ft. above the fire grate and is built with an air space extending to within 30 ft. of the top. The core is circular with an inside diameter of 9 ft. The foundations are 42 ft. square and are piled. The draft obtained is equivalent to the pressure of a column of water ¾ in. high.

The engine and dynamo room, Fig. 3, is 235 ft. long and 89 ft. wide and is provided with two travelling cranes of ten tons capacity each, one for the dynamos and the other for the engines. The room is lit at night by over 200 incandescent lamps and during the day receives an abundance of light through the windows and the roof-light.

The equipment at present comprises six cross-compound condensing engines made by the Laurie Engine Co., of Montreal, and rated at 800 H. P. each. The cylinders are steam jacketted and have a diameter of 24 in. and 48 in., for the high and low pressure cylinders, respectively, with a stroke of 4 ft. The fly wheels, which have a gross weight of 42 tons each, have a diameter of 22 ft., giving a peripheral velocity of nearly 4,900 ft. at 70 revolutions a minute. The wheel pits are constructed of sheet iron and are water-tight to prevent the entrance of water in case of a flood.

The engines are located in a row along that side of the room

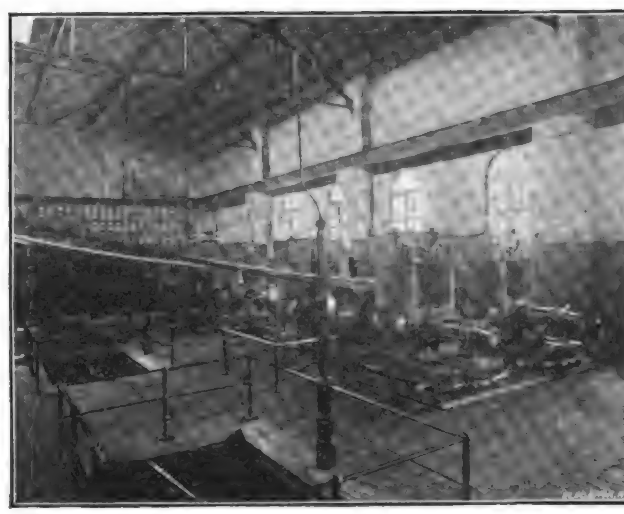


FIG. 3.—ENGINE AND DYNAMO ROOM.

which is next the boiler room and have solid foundations of brick and cement carried down from 6 ft. to 8 ft. below the street level. At the end of the room is place for two additional engines with their dynamos, which will be installed when needed. It will be noted that some of the engines drive dynamos having considerably more than their rated capacity, but they have proved to be able to carry these loads without difficulty.

Under the engine and dynamo room is a high basement in which are a Northey and five Worthington condensers, one for each engine. Water for condensing and other purposes is obtained from the Lachine Canal, 700 ft. distant, through a 20 in. main, and the waste water is returned to the canal through another main of the same size.

The dynamos are arranged in a row opposite the engines and comprise twelve No. 80 Edison generators of 200 K. W. capacity each and six multipolar generators of 300 K. W. capacity each, all built by the Canadian General Electric Co. The twelve Edison generators are driven by three of the engines, each of which drives four generators by means of four 24 in. belts, arranged as a double tandem drive on its fly wheel. Each of the three remaining engines drives two of the six multipolar generators by one 54 in. belt and one pulley. To accomplish this, two generators are mounted on the same bed plate with a pulley between them, belted directly to the engine as shown in Fig. 4. The armature shafts and the pulley shafts are in alignment and are connected

together by two Hirt friction clutches. Thus one or both of the generators of each pair can be driven from the same pulley.

A novel and interesting feature of the switchboard, shown in Fig. 5, is that it is constructed of terra cotta lumber cemented with adamantine plaster. Besides the saving of expense effected by the use of these materials, the board has the advantage that it can be easily drilled and, furthermore, as it is made in one piece without joints, there is but little liability to breakage. An additional advantage is due to the absence of the iron frame required by a panelled board, but not needed by one of this construction. The board is 62 ft. long, 11 ft. high by about 9 in. thick and is located on a wide gallery 7 ft. above the floor, which extends nearly all the way across the front of the room. Around the edges, is a wide moulding of polished cherry, and the front is covered with enamel so that the board presents a very handsome appearance.

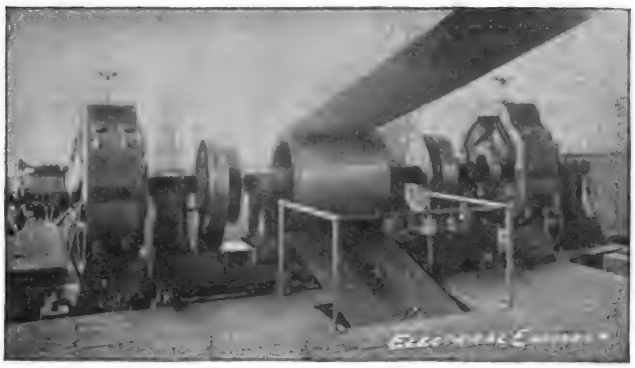


Fig. 4.—Twin Multipolar Generators.

The instruments for the six multipolar generators are the same, but are of a larger capacity and are located next on the board. The rheostats for regulating the generators are under the floor of the gallery and are operated by shafts extending upwards through the floor. The voltmeter and the main circuit ammeter are Weston station instruments and are mounted on a marble panel set at right angles to the switch board at one end of the gallery, in which position they can be seen from any part of the gallery. On the same panel are a Bristol recording voltmeter, a thermometer, a barometer and a clock.

The overhead construction is of the standard type. Iron side poles of the Morris-Tasker sectional pattern are used and are set an average distance of 110 feet apart. Wooden poles were employed temporarily on some of the lines, but have now been replaced almost entirely by iron poles. The trolley wire is No. 00 B. & S. gauge, of hard-drawn copper, and is supported by "West End" hangers with mechanical clip. The span wire is No. 9 B. & S., three-ply galvanized iron wire, and is secured to the poles by Brooklyn strain insulators. The guard wires are also of No. 9 galvanized iron wire. Ætna section insulators and straight underrunning frogs and crossings are used. The feeders are No. 0000 copper wire, and are both solid and stranded. Track return feeders of the same size are employed, but have only one half the carrying capacity of the trolley feeders, which is sufficient owing to the low resistance of the track return.

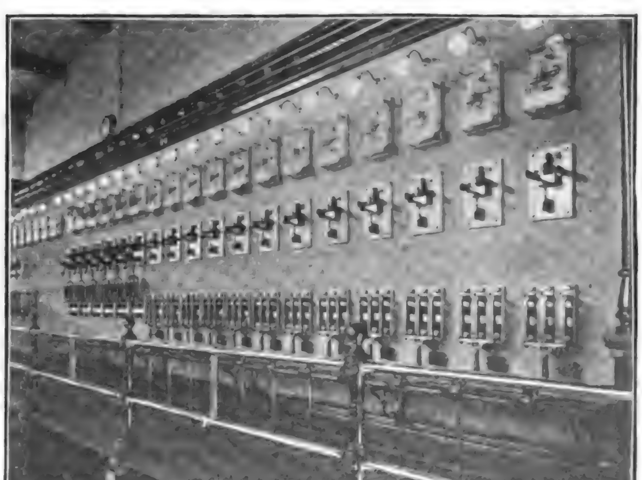


Fig. 5.—Switchboard of Terra Cotta.

The bonding is done with No. 4 copper wires soldered to rivets driven in the rails and interconnected at short intervals. In addition the fish plates are large and each is bolted to the rails by six bolts so that the connection between the rails is good and the track return has a very low resistance.

On streets paved with stone or wood blocks or asphalt, which have a concrete foundation, the rails are laid directly on the concrete according to the English method, Fig. 6, and thus differ from the usual construction on this continent. The track, which is a good example of this method of construction, is standing the heavy traffic and extreme cold very well; portions laid over two years ago show no signs yet of yielding at the joints or giving out elsewhere.

The rails were imported from England and are of the grooved girder type, 6½ in. high and weigh 72 lbs. to the yard. In laying the tracks, shallow trenches about 1 in. deep and wide enough to admit the rails, were excavated in the concrete foundations of the streets. The rails were laid in the trenches and levelled by thin pieces of oak. The rails on one side of the track were connected with those on the other side by iron rods, and a grout composed of equal parts of cement and sand was poured in the trenches so as to cover the flanges on the rails. Both sides of the webs of the rails were also filled with the grout to the width of the rails, the wood or stone blocks were then replaced and all crevices filled with grout. On streets paved with asphalt, scoria block headers were generally used next the rails. At intersections and curves, the rails were spiked to wood ties bedded in concrete and on streets which have no permanent pavement the rails were also laid on ties.

The main repair shop is conveniently located in the centre of the city, on Coté St., near which all the car routes pass. The shop is a two-story and basement brick building, 150 ft. by 115 ft., and is heated by steam and lit by incandescent lamps. The larger part of the upper floor is devoted to a shop for car body repairs and the remaining part is for armature winding and electrical repairs. In another building connected with the armature room by a bridge, is an oven for baking armatures and commutators. Here also are the stock room, pattern room and offices of the shop superintendents.

In the same location is an emergency station containing an emergency wagon and comfortable quarters for the men who are always on duty and respond to fire alarm calls, cars-off-the-track and any trouble calls. The station is provided with a single gong connected with the city fire alarm system and a telephone. The store room for line material is conveniently located in the same building.

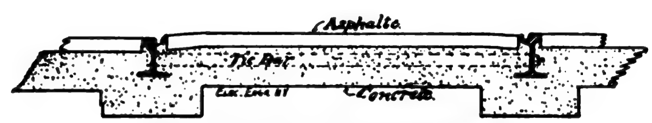


Fig. 6.—Rails Laid in Concrete.

Car barns with pits and appliances for making ordinary repairs are located in three different places on the out-skirts of the system. Those at St. Henry and on St. Denis St. with a capacity for 54 and 37 cars, respectively, are very conveniently arranged and are worth special mention.

The rolling stock is nearly all of Canadian manufacture. The motor cars are equipped with series-parallel controllers and with Edison General Electric, Royal and Westinghouse motors. The cars are equipped with fenders and in winter are fitted with vestibules and heated by stoves. Blackwell trucks made by the Canada Switch Manufacturing Co., of Montreal, are used.

The rolling stock also includes 9 snow sweepers, of which 3 were made in the company's own shops and are equipped with motors of the company's own manufacture, and with "K" controllers, made by the Canadian General Electric Co. In Montreal where the snow remains on the ground all winter and accumulates on the streets to a considerable depth, it is not sufficient to keep the tracks clear of snow by the sweepers, but the snow must be removed in sleighs from the streets in which the cars run. In removing the snow, a layer 8 or 10 inches deep on each side of the track, is left for sleighs, which are the only vehicles used in winter. The company keeps its tracks clear with sweepers, and shares the expense of removing the snow from the streets which is done by the city. Under these severe climatic conditions, every precaution must be taken to keep the tracks open, and the superintendent watches the reports of the weather bureau very closely. When a snow storm is predicted, extra men are engaged and everything is made ready to cope with it. An idea of the work and trouble created by a Montreal snowstorm may be inferred from the fact that in December, 1893, the total snowfall aggregated 40½ inches.

The capital stock of the company is $3,000,000, with a bonded indebtedness of $973,333. The net earnings for the year ending

Sept. 30, 1894, were $258,422, an increase of nearly 64 per cent over the previous year, out of which two dividends of 4 per cent. were paid and $37,354 added to the surplus.

In 1892 the number of passengers carried was 11,631,386 and in 1894 the number was 20,569,013, which figures show that the traffic has nearly doubled within the two years during which the trolley system was introduced.

THE THREE-PHASE RAILWAY SYSTEM AT LOWELL, MASS.

THE first adaptation of the three-phase system to the operation of the electric railway was that carried out by the General Electric Company on the Norwich, Conn., road. In this instance three-phase current generated at Baltic is brought over a distance of four and one-half miles, to Taftville, where, in the basement of the Ponemah Mills, it drives a synchronous motor, which in turn not only operates all the machinery in those extensive mills, but, through countershafting, drives several direct current generators furnishing current for the operation of the Norwich Street Railway, as well as for that of a forty-ton electric locomotive used as a switching engine in and around the Taftville Mills.

For the next instance the continent must be traversed to Sacramento, Cal., where current is brought at 11,000 volts from the water driven generator station at Folsom, twenty-four miles away. This is transformed at a sub-station and led to motors belted to the direct current generators which supply the ordinary 500-volt current to the motors on the Sacramento street cars. This plant is now in daily operation and no difficulty has been encountered since the start.

In both these instances, it will be seen that the three-phase current is used to drive motors which in turn drive direct current railway dynamos of the usual pattern. At Lowell, Mass., however, the General Electric Company has recently adopted an entirely different method, which dispenses with the second step, *i. e.*, the employment of the motor driven direct current generator. Its place is taken by a machine, which is, in reality, a motor and a generator in one.

The company to which falls the honor of first using the three-phase system directly in its railway service is the Lowell and Suburban Railway, which, under the guidance of Mr. P. F. Sullivan, a man of energetic and progressive stamp, is now taking a step which should indubitably add largely to its revenues. The problem before the Company was, how best to connect its terminus at Lakeview, a delightful resort on the Lake, owned by the Company, with the car line leading to Nashua, fifteen miles away. The solution was found in the use of the three-phase system, but not before careful examination had been made of its merits, from the points of view of economy, efficiency and durability and comparison with other systems.

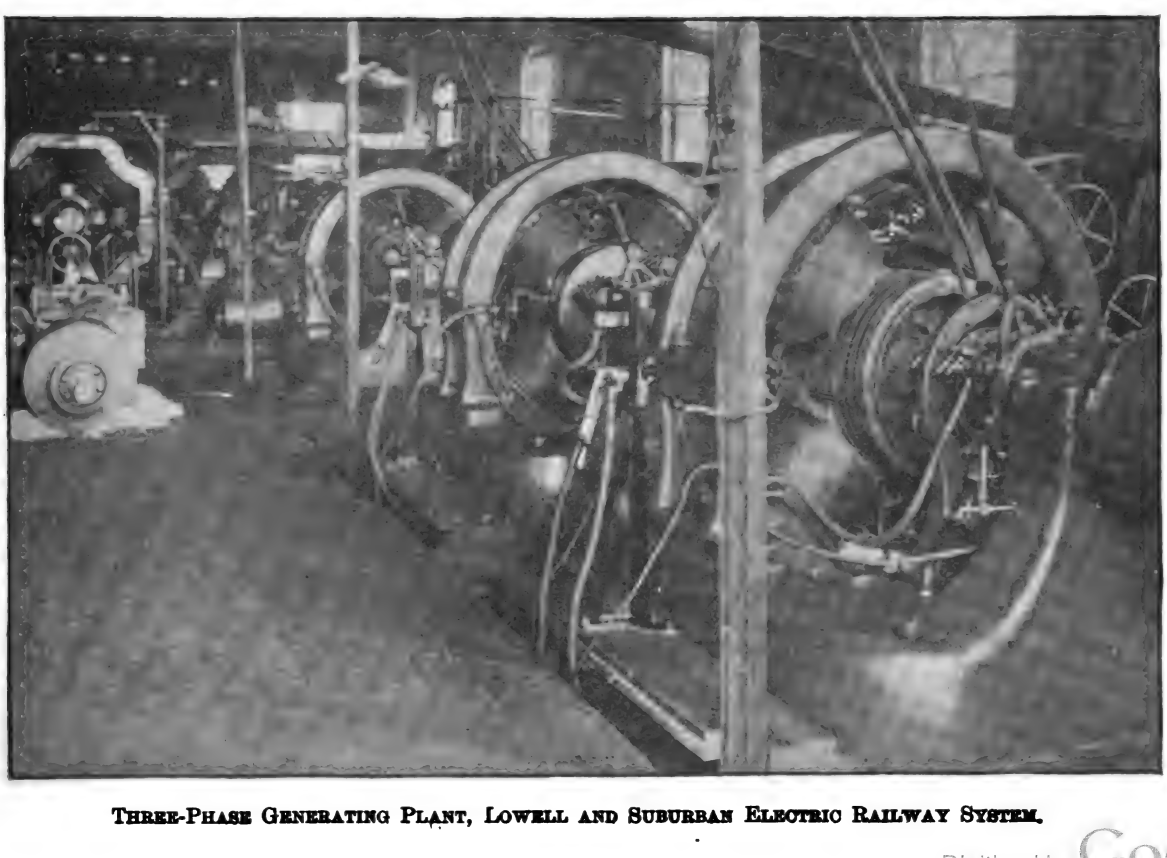
Briefly, the principle of the installation is this: The three phase current generated at Lowell, is, at a pressure of 5,500 volts transmitted, part to a point about midway between Nashua and Lowell, and part to a substation at Nashua itself. It undergoes at both these points, first a reduction of pressure in static transformers, and then a conversion from the three-phase current in a

SUBSTATION FOR CONVERTING THREE-PHASE TO 500 VOLT DIRECT CURRENT.

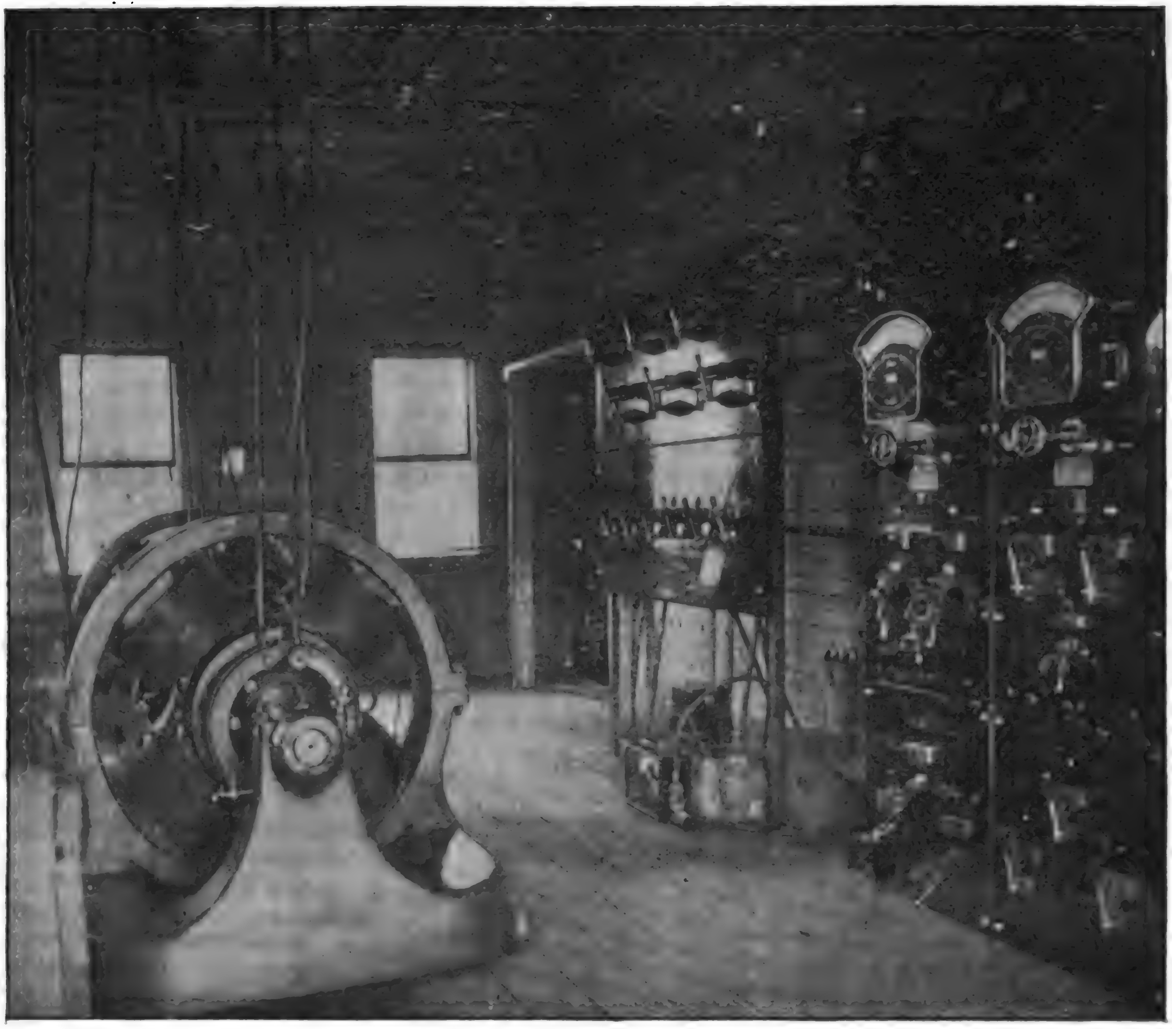
rotary converter, emerging upon the feeder and trolley lines a direct current of 500 volts.

The three-phase generating plant is located in the power house of the Lowell and Suburban system, situated on Middlesex street. It consists of three, four pole 120 K. W. 900 revolutions, three-phase generators, each of which is constructed to deliver alternating current at one side and direct current at the other. The direct current is called into action only after the main power plant, consisting of six General Electric M. P. 200 K. W. belt driven railway generators, is shut down.

The three-phase generators are compact machines, and are connected by belts to a jack shaft which runs the entire length of the engine room close to the west wall. This shafting has been arranged to permit of any combination of engines and generators



THREE-PHASE GENERATING PLANT, LOWELL AND SUBURBAN ELECTRIC RAILWAY SYSTEM.



THREE PHASE ROTARY TRANSFORMERS AND SWITCHBOARD IN SUBSTATION.

the combinations being made by means of clutches. The generators are rated at 216 amperes. The three-phase current issues at a pressure of 360 volts and is carried to the switchboard, from which it passes to a bank of transformers, erected on a platform, placed in the cellar of the station and set between two of the engine foundations. These transformers are of the General Electric air blast type. They are cooled by a blast of air driven through them by a rotary blower belted to a 1 H. P. motor.

From the transformers the three-phase current issues at a pressure of 5,500 volts, and is carried over insulated cables to a short distance outside the city limits, where it passes to the ordinary three-phase wires which run along the highway upon the same poles that carry the direct current feeders. The three-phase wires are carried upon heavy, wide, petticoated glass insulators, set upon the side of the cross arm near the road; while the direct current feeder cables occupy that part of the cross arm on the other side of the pole.

About six miles from Lowell, and a mile and a half from Lakeview, at a place called Eayr's Mills, upon the banks of the Merrimac River, the first substation has been erected. This is a wooden structure divided by a partition into two rooms, the outer, or that nearer the line, being occupied by the rotary converters and direct current switchboards; the inner containing the bank of reducing transformers, also cooled by air blast, and the three-phase switchboard.

The three phase current is brought into this building from the pole over cables, to the transformers just mentioned. In these the pressure is reduced from 5,500 volts down to the original pressure of 360 volts. The current then passes into the outer room to the two rotary converters; it issues therefrom, railway direct current of 500 volts pressure, and is carried to the direct current feeders and trolley wires.

These rotary converters are similar in appearance to the three-phase generators, having at one side collector rings at which the three phase current is received, while at the other is a regular commutator from which the direct current is taken.

From the two converters the 500 volt current is carried to the feeders and is fed into the trolley wires, towards Lakeview and Lowell in one direction and towards Nashau in the other through a regular railway switchboard of panel construction. The substation at Nashau is identical with that at Eayr's Mills. It contains two rotary converters, feeding part of the current into the main railway line from the Nashua end, and part into the City lines. The operation of the rotary converters has proved entirely satisfactory. The machines have been subjected to heavy overloads, sometimes running as high as 50 per cent. more than the rated capacity, without any detriment.

The cars running between Lakeview and Nashau, are of special

STATIC TRANSFORMERS IN SUBSTATION.

make and hold a place about midway between the steam railroad car and the regular street car. They are fitted with sixteen benches, and are mounted upon two independent trucks. They are equipped each with two G. E. 800 motors, controlled by "K2" controllers. The speed attained on the open highway between Lakeview and Nashau, reaches as high as thirty miles an hour without difficulty.

The traffic between the two last mentioned points is already very large and the line has brought the inhabitants of the two busy New England manufacturing cities into closer connection than ever. It enables also the inhabitants of the little hamlets scattered between to come to either for a moderate fare, which is only ten cents for the entire distance, or five cents from either to Lakeview.

The carriage of freight, by special freight cars has, we believe, not yet been contemplated, but now that the facilities exist this service will probably be started later on.

It is expected that the success which has attended this installation, will be the precursor of a new era in travel; already numerous inquiries have come in regarding the possibility of the adaptation of the system to transit between towns, holding a relation similar to that between Lowell and Nashua.

THE NEW STANDARD AIR BRAKE FOR TROLLEY CARS.

One of the most instructive papers read at the last meeting of the American Street Railway Association, at Atlanta, last year, was that by Mr. E. J. Wessels, general manager of the Standard Air Brake Co., of New York. Mr. Wessels has had unusual opportunities of studying the brake question from every standpoint, and the value of his Atlanta paper may be judged by stating that two editions of it were called for. Since that paper was ready the Standard Air Brake Co., has still further improved its apparatus. These advances will become apparent on inspection of the accompanying engravings. Fig. 1, illustrates the Company's special air-reservoirs, brake cylinder, service-valve, regulating-valve, and compressor with suspension-truss; and Fig. 2 shows the service-valve with air-ports, pressure-gauge, controlling-handle, staff-casings, stay-plates, hose-holders, etc.

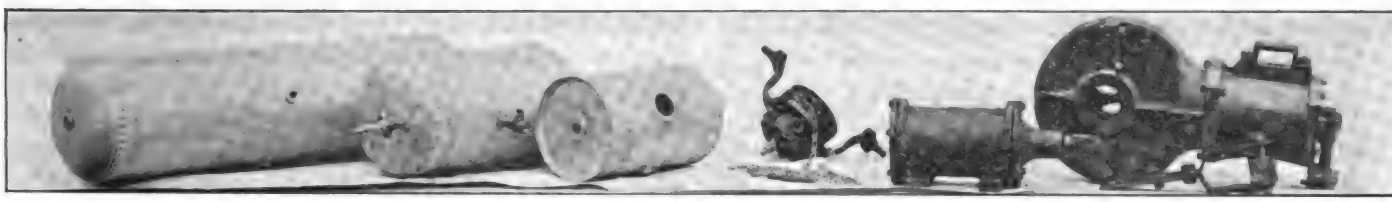


FIG. 1.—THE NEW STANDARD AIR BRAKE.—SPECIAL AIR RESERVOIRS, BRAKE CYLINDER, SERVICE VALVE, ETC.

It will be noticed that the air-compressor is mounted on the car axle. Formerly from eight to thirteen inches free axle space was required, but the present compressor does not require more than six inches. By means of this improvement it has become possible to equip almost any car, no matter how the truck and body may differ from other cars.

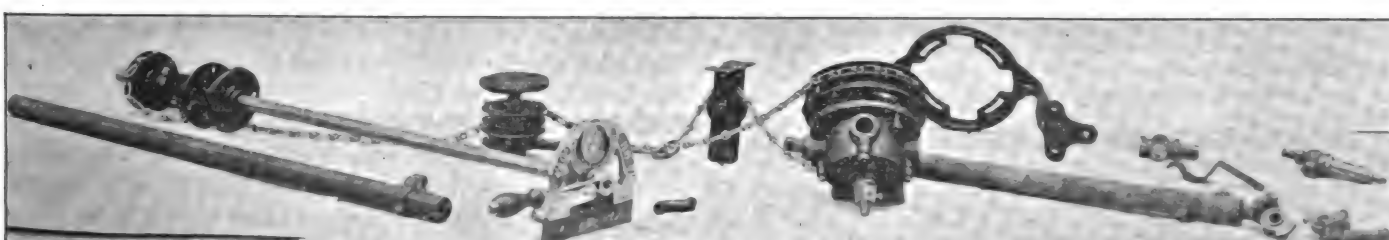


FIG. 2.—THE NEW STANDARD AIR BRAKE.—SERVICE VALVE WITH AIR PORTS, PRESSURE GAUGE, ETC.

The Company's patents cover a number of novel features, all of which have been carefully worked out. The entire Standard system is arranged to require a small amount of space, and the outfit is compact and exceedingly strong, being built for great durability. Formerly the exhaust was noisy, but that feature has been remedied and there now is no puffing or hissing to frighten horses or pedestrians.

A valuable feature has been added in placing the pressure-gauge directly under the controlling-handle, so that the motorman or gripman has before him constantly a record of the pressure available for braking.

The company does not believe in using four or five pounds of air for a stop, and its apparatus has been designed so that a quarter to a half pound of air does the work which formerly took three. In the storage-reservoirs, when full, there is enough air to admit of from fifty to one hundred effective stops, even if no further air were compressed. With such ample braking power available, a motorman may always have confidence in his ability to brake his car under all circumstances. The Company adheres strongly to the principle that the braking power should be divorced absolutely from the propelling power, and it does not believe in using an electric current directly or indirectly for braking on account of the danger of breaks in the line at a critical moment.

One great advantage of the Company's system is the fact that it applies to trailers as well as motor cars, and by the use of the Standard air-brake, the motorman or gripman has entire control of one car or of a train of cars. The saving in brakeman's wages soon pays for the cost of the equipment.

DETROIT MAY OWN ALL THE STREET CAR TRACKS.

The most remarkable document yet produced in connection with Detroit's long street car war was that sent to the common council by the Detroit Railway last week, unless, indeed, Mayor Pringree's letter accompanying the proposition and indorsing it, be considered more worthy of note. Briefly stated, the proposition of the Detroit Railway is that the city shall obtain possession of the Citizens' company's tracks and lease them to the Detroit Railway at a rate of $3\frac{1}{2}$ per cent. interest on the amount paid for them—the Detroit Railway to pay for all cars and overhead equipment and to keep the road in repair while the city would pay for all repaving. Moreover Mr. Pack's company is willing to sell its own entire trackage to the city and then lease the lines from the latter on the same terms proposed for the lease of the Citizen's company's tracks, $3\frac{1}{2}$ per cent. on the purchase price. Any necessary renewal of tracks is to be paid for by the city and the cost added to the amount upon which such interest is to be paid by the company. The latter agrees, in case such an arrangement is entered into, to carry all passengers on all lines at all times, day and night, for a uniform fare of three cents, to give universal transfers and to sell 40 tickets for $1. As an evidence of good faith the company offers to give a bond obliging itself to enter into the proposed contract, and binding it to make the offer to each succeeding council until a final contract is signed.

THIS IS NOT A COLOR LINE.

The first colored man to work on a street car in Detroit was appointed motorman on one of the trolley cars running on the principal route in the city a short time ago.

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"Enclosed find 60 cents for which please send by return mail one of your morocco Filing Cases. The Data Sheets I consider the finest thing published for practical men. There is only one fault, we do not get enough of them. I desire also to say that I consider your paper at the top." Will. A. Hunt, Baton Rouge, La.

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CONTENTS.

SUPPLEMENT.

THE CONFRONTING STREET CAR PROBLEMS.

FOR the first time in the history of its organization the American Street Railway Association has gone beyond the borders of the country for a meeting-place. The selection of Montreal, which has become a favorite rendezvous for many societies, will, if anything, secure a larger attendance than ever before, and thanks to the attractions of the city and its vicinity the members may be reasonably sure of a pleasant stay. But besides the mere recreational features awaiting them in Montreal, the delegates will probably find more serious matters for their attention; and there would seem to be wide scope for useful discussions. We might mention a dozen topics which would, we believe, "pan out" well. Thus the relation of track to the motor and car is still as alive as ever. In spite of the improvements which were suggested by early experiences, the fact remains that motors and cars are getting heavier and heavier, and joints are being pounded more viciously than ever before. Assuming that the weight of the present type of machines has been reduced to the lowest possible limit, and that car-bodies and trucks have been similarly treated, there are available two possible remedies. These lie either in the improvement of the method of suspension of the motors, or in the return to a lighter type of motor and car. Taking as a type the 25 H. P. railway motor largely used at the present time we find it to weigh close on to 1,500 pounds, of which nearly one-half is carried on the axle; and to this is to be added the weight of the gears and gear cases, which may be taken at an additional 300 pounds, thus bringing the weight resting on the axle close on to 900 pounds Improved types of suspension have no doubt tended to relieve the effect of the hammer blow due to this weight, but much still remains to be done. It may be considered heretical to propose as a remedy a return to the high speed motor in order to reduce the weight, but the recent successes claimed in Switzerland with the screw and worm type of gear make the proposition well worthy of renewed attention on the part of manufacturers. High speed indeed by no means involves double reduction, while as regards efficiency it will not be denied that the early double reduction motors were the peers of the present type of single reduction machines.

Another topic which may well occupy the attention of the Association is the application of the alternating current to railway work. We have already chronicled a number of instances of the application of the three-phase system to the covering of long railway lines, and this week we describe another large application of the same kind at Lowell, Mass. It is evidently now only a question of time when the alternating current will be applied directly to the motor on the car. That the large manufacturing companies are alive to the situation is evidenced by the experiments in this direction which we are informed are now being actively prosecuted, and we know that a direct application of the alternating motor to a road about to be equipped is now seriously under consideration by its engineers. To be sure, the two wires required for its overhead work will militate against the introduction of the alternating system in cities, but for interurban roads which are now rapidly increasing and which are practically free

from the danger of crosses from overhead wires, there appears to be no valid objection to the use of two wires.

Brakes and fenders, the two bugbears of electric railroading, would probably also afford themes for profitable discussion and there is none which appeals more directly to the railway manager, whether viewed from the humanitarian or the economic point of view. It has been truly said that the best fender is a careful man at the brake handle, but evidently if the brake is not adequate to its task, or too slow of action, the most cool-headed motorman is at a disadvantage. It may be stated with a tolerable degree of certainty that it is only a question of time when a power brake of one type or another will be exacted on electric street cars, in the same way as fenders are now being called for by numerous city ordinances. The air brake has already proved its title to recognition in actual practice, and the electric brake will not be long, we hope, in attaining a similar position.

Whether discussed on the floor of the Convention or privately among the members, the question of prices of apparatus and supplies will, as it usually does, draw the members together for exchange of experiences. The low figures now generally obtaining, added to the fact that most electric railway companies are in a position to repair and, if need be, replace their equipment in their own shops, has materially changed the aspect of matters in this regard. And this brings us to the general question of the future outlook for electric railway supplies, using the term in its true sense, as differentiated from equipment.

A railroad system once built and in operation requires but a comparatively small amount of supplies of a strictly electrical nature, in this respect differing greatly from electric light stations, which call for a continual supply of lamps, sockets, carbons, wire, cleats, moulding, switches, motors, fans and a dozen other construction details all the year around. While this is a fortunate circumstance from the railway standpoint it may well claim the consideration of the manufacturer who has an eye to the future.

We might go on mentioning other topics of a like nature, but enough has been said to indicate the wide scope of the field for useful discussion. It is to be hoped that the real business of the Association will not be neglected for the lighter side of these gatherings as it was at Atlanta, and that the proceedings will add to the sum total of useful knowledge on the art of electric railroading.

AMERICAN AND ENGLISH TELEGRAPHIC FALLING OFF.

The figures were published last week by the Western Union Telegraph Company which show its year's business, and by coincidence the figures of the English Postal Telegraphs for 1895 also came to hand by last steamer. They are singly and jointly an interesting study. While they show a remarkable and encouraging stability, they yet lack healthy growth and appear to us to confirm the views recently expressed in these pages as to the fact that the telephone has now taken up the part of supplying the public with the best and most rapidly extending facilities of rapid intercourse. This is said, of course, without any prejudice against the telegraph as such, or preference for the telephone as such; and is merely what seems to us to be a fair interpretation of the existing conditions. A leading English contemporary, the *Electrician*, fails to see any great gain of the telephone over the telegraph, although the use is as 10 to 1, and it does not believe that positions will hereafter be changed relatively. The opinions of that journal are always entitled to weight, but we venture to adhere to our own views and more strongly than ever with the subjoined statistics confronting us.

The business of the Western Union is set forth in the following exhibit :—

	1895.	1894.	1893.
Miles wire............	802,651	790,792	769,001
Offices	21,360	21,166	21,078
Messages sent.........	58,307,715	58,632,237	66,591,855
Average toll per message..................	30.7c	30.5c	31.2c
Cost per message.....	23.3c	23.3c	22.7c

It will be seen that since 1893, the Company has lost a business of over 8,000,000 messages, and that nevertheless it costs nearly 1 cent more per message to handle the business it still retains. Admitting that the Postal Telegraph Co. has drawn off the difference and added a little new business of its own, it must be obvious that there is no increase of business proportionate in any degree to the increase of population, mail matter or telephone messages. It might be said that these are dull times, but certainly not worse than 1893, and, besides, telegraphy under old conditions should have got much traffic due to the fact that the railroads were less used for intercommunication since the great panic. But there is an utter absence of elasticity. Gen. Eckert must be congratulated that under such a state of affairs for which he is in no wise responsible he has been able by good management to keep up 5 per cent. dividends and show a net increase in gross revenue of $365,364. But would it not be worth while to see whether the telegraph cannot be brought up to a higher ratio than 1 message per year per head of population?

Turning to the English figures, we find the grave deficiency for the year of $2,250,000. The business through a series of years shows up as follows :

Year.	Receipts plus nominal value of work done for other Departments.	Expenditure.			Annual interest on capital.	Deficit.
		Charged to Telegraph vote.	Charged to votes of other Departments.	Total.		
1888 89	£2,129,965	£1,969,324	£72,037	£2,041,361	£353,787	£265,183
1889 90	2,364,099	2,179,921	99 065	2,278,986	306,016	197,690
1890-91	2,456,764	2,265,338	123,243	2,388,581	299,215	231,032
1891 92	2,545,612	2,507,012	124,883	2,635,895	298,888	389,166
1892-93	2,528,312	2 567,019	125 975	2,693,994	298,888	465,570
1893-94	2,579,206	2,641,020	116,625	2,757,645	298,888	477,327
1894 95	2,646,414	2,675,339	124,990	2,800,329	298,888	452,803

In other words, the English nation has lost in 7 years over $12,250,000 on its telegraphs, and would therefore appear as a telegraphic company to be in infinitely worse condition than the Western Union, which is at least solvent and paying dividends. The number of all messages in the United Kingdom was 71,589,064, a gain of 689,566; which bears out our contention that were England, like the United States, a free user of the telephone, she would not show nearly 2 messages per year per head, but would find the telephone catching a very large proportion of the new "business." This is shown by the fact that the gain in metropolitan messages was barely 250,000, due to the sharpness of the telephonic competition.

POWER TRANSMISSION.

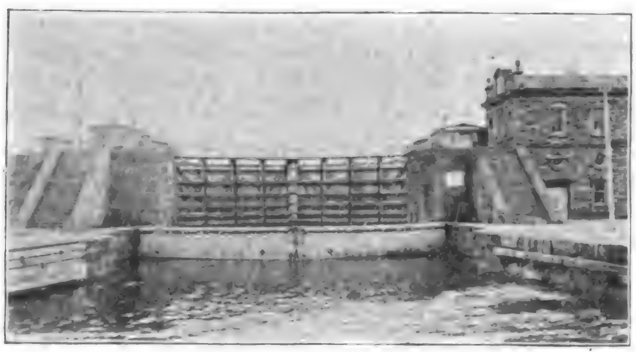
THE CANADIAN SHIP CANAL LOCK AT SAULT ST. MARIE AND ITS ELECTRICAL OPERATION.

James B. Spence, C. E.

THE opening of Sault Ste. Marie Ship Canal, on the Canadian side, which took place on Sept. 9, marks the inauguration of one of the most important public works thus far undertaken in Canada, ranking in its nature only second to the Welland Canal itself. This canal and lock, the location of which will became clear by an inspection of the accompanying map, p. 381, is designed to carry large sea-going vessels around the 18 foot fall of the "Soo" Rapids, connecting Lake Superior with Lake Huron.

The total length of the new canal across St. Mary's Island is 3,500 feet, and the dredged approaches under water at the two ends are about 18,000 feet long, with a depth of water of 21 feet. The essential feature of the work is, of course, the lock by which the 18 feet fall of the Sault Ste. Marie is overcome. This lock is built of masonry, and is 900 feet long between quoin posts, and 60 feet wide, with a depth of water of 20¼ feet on sills at low water. The height of the top of the walls above the floor of the lock chambers is 43¾ feet.

There are five sets of gates, two at the upper or west end, and three at the lower end, that is, a lock and guard gate at each end and an extra or auxiliary lock gate at the lower end for immediate use in case the lower main gate should get injured. Two sets of these gates (the lower main and auxiliary) are 44¼ feet in height x 37 feet in width, weighing about 87 tons per leaf. The guard gates are, of course, to be used only when the lock chamber is being pumped out for examination or repairs. Water is admitted to the lock chamber by four 8 x 8 ft. culverts, extending under the breast wall and underneath the floor and having openings at their tops. The inlets and outlets to these culverts are closed by butterfly valves 10¼ x 8 ft. area, constructed of steel. Both the valves and gates are operated by electric power.



LOWER GATES AND POWER HOUSE.

In all there are six gate machines, one for each leaf of the upper lock gate, lower lock gate and auxiliary gate. A one story wooden motor house covers each of the gate machines and its connecting motor. Four of these houses as shown on the plan, p. 381, are L-shaped, this additional portion being to enclose in the same building the valve machine and its motor.

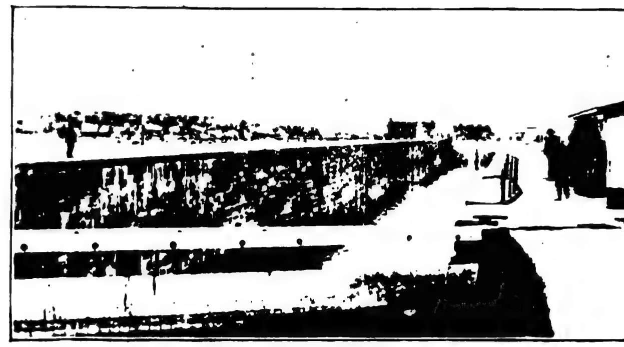
With this machinery, from actual practice, the time required to pass a vessel through the lock going up stream is, after the vessel has taken her place in the chamber, 50 seconds for closing the lower gates, plus 50 seconds for opening the valves, plus 7 minutes for filling the lock, plus 50 seconds for opening the upper gates, or 9¼ minutes altogether. As the lock can be emptied in 5 minutes a vessel can be locked down in 7½ minutes.

The motors are governed by automatic switches, operated by what may be called cut-off, or adjustable tripping bolts, which push the switch handles over and thereby cut off the current, so that the cross heads will not go beyond the intended point.

The tripping bolts (which push the handles) are adjustable in a slot by a nut and washer on the back of the plate, so as to make them cut off sooner or later, or to the point required. These tripping bolts are insulated by 3-16ths of an inch hard rubber sockets, and washers, so as to prevent the current from passing on to the metal of the machinery. Cords run from the switch handles to pulleys on the ceilings, and by these are conducted to the controllers, and the switches are closed by the motorman pulling the cords without having to leave his position. By this arrangement the danger of damage to the machinery (from the cross head running ablock at the ends of the screws) is prevented.

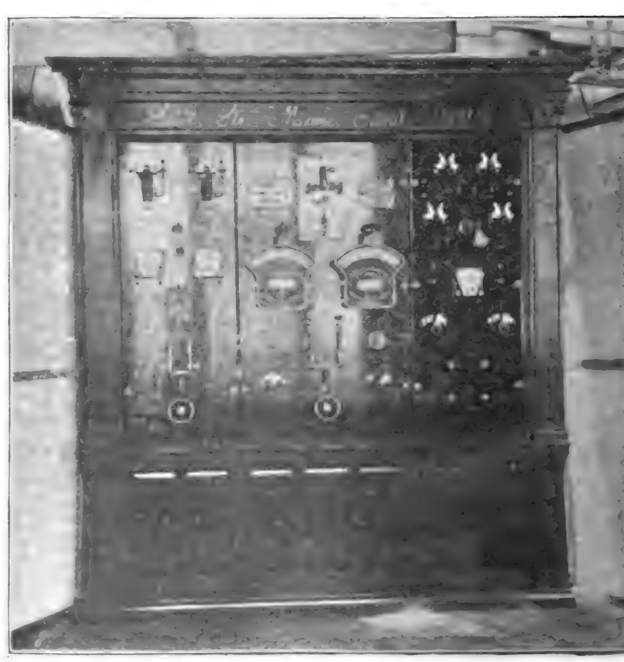
The machinery which has been described is the first electric power machinery ever used for operating the gates and valves of canal locks. For both the old 1881 lock and the new 1800 feet lock on the American side of the St. Mary's river, hydraulic machinery is used.

The reasons which led Mr. James B. Spence, chief draftsman of the Canadian Department of Railways and Canals to adopt electricity were that the difference between electric and hydraulic power would be very trifling, and here the point of economy was not taken into consideration. Besides, one of the main objects of using electricity was to overcome the great trouble caused by frost when hydraulic machinery is used. During the closing weeks of navigation the cold is so great that oil has to be used in the hydraulic engines placed on the lock walls, and even then the cold causes the oil to thicken and makes the action of the engines slow and tedious. Of course, frost would not have interfered with hydraulic valve engines placed at the bottom of the lock, but in this case eight engines would have been required, while only four screw power machines are needed with the machinery as designed. These considerations seemed to make it advisable to use electric power throughout.



THE LOCK FROM WESTERN END.

Two 45 in. 155 H. P. turbines, equalling a combined power of 310 H. P., supply the power for operating the generators and pumps. One turbine will be used for running the generators, the other for running the arc light dynamo and general shop work, but when it is required to pump out the lock, the two wheels can



SWITCHBOARD IN POWER HOUSE, SAULT ST. MARIE CANAL LOCK.

be coupled and used to operate the centrifugal pumps. There are two of these pumps, and they have a combined capacity of 32,000 gallons per minute. The two pumps will lay the lock chamber dry in between 6 and 7 hours.

It should be noted also that near the upper end of the supply pipe there is a 6′ 8″ valve operated horizontally by two Tobin bronze screws; also two 5 ft. valves are placed in the supply pipe immediately above the power house, permitting of either the whole of the pipes or of either or both turbines being laid dry when necessary. There is also an auxiliary 18 inch turbine for driving the incandescent lighting dynamos independently.

The electrical plant for operating the gates and valves and for lighting the canal and approaches, was supplied by the Canadian General Electric Co., Ltd., of Toronto and Peterboro, under detailed specifications drawn up by the government electrician, Mr. D. Bryce Scott. The current for power purposes is supplied by two 45 K. W. 500 volt Edison standard bi-polar dynamos, either of which is of sufficient capacity for operating under normal conditions.

The lighting plant consists of a No. 7 Wood arc dynamo, having a capacity of forty 2,000 C. P. lamps, and a 3 K. W. Edison bi-polar incandescent machine for lighting the power house and repair shops.

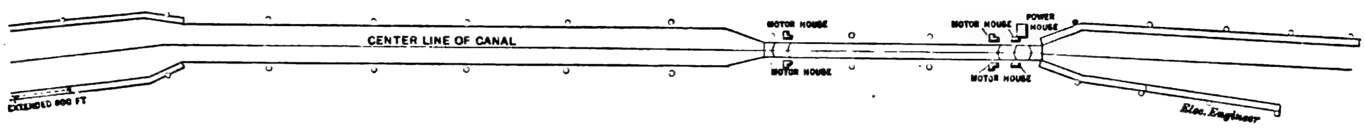
The switchboard, illustrated on p. 380, consists of three polished black slate panels 7 ft. long by 5 ft. wide and 2″ thick. These are supported by a heavy oak frame of ornamental design. The centre panel carries the instruments and controlling apparatus for the power generators, while on the right is the arc machine panel and on the left that for the incandescent machine.

The motors operating the gates are the Canadian General Electric Co.'s 50 H. P. railway type, and are operated in pairs by parallel controllers, the connections across the canal being made by heavily armored submarine cables. The valve motors are also connected in pairs in exactly the same manner as described above.

The lighting of the canal and approaches is accomplished by means of a row of arc lamps down each side of the canal, situated at about 300 feet apart, as shown in the plan above. These lamps are double carbon of the standard "Wood" type and are supported by means of iron poles and hoods placed on the top of 40 ft. poles.

In order to obtain perfect regulation without putting unnecessary strain upon the generators during idle periods, Mr. Spence placed a mitre wheel upon the end of the turbine shaft, arranged to drive a horizontal mitre wheel placed on an upright shaft which extends deep in the well and firmly secured in the bottom step. On this shaft are placed two propeller wheels of a size to meet the power required, one facing up and the other down, which causes no undue strain either up or downwards. When the regulator is not required, such as when running the large centrifugal pumps, the horizontal mitre wheel can be uncoupled. In this manner the object has been accomplished satisfactorily.

The lock, lock gates and power house and all the valve and gate machinery were designed by Mr. James B. Spence, of Ottawa, to whom we are indebted for the information contained in this description, and the uninterrupted smoothness with which the entire work has operated since the opening of the new lock, indicates the thoroughness with which every detail has been worked out.



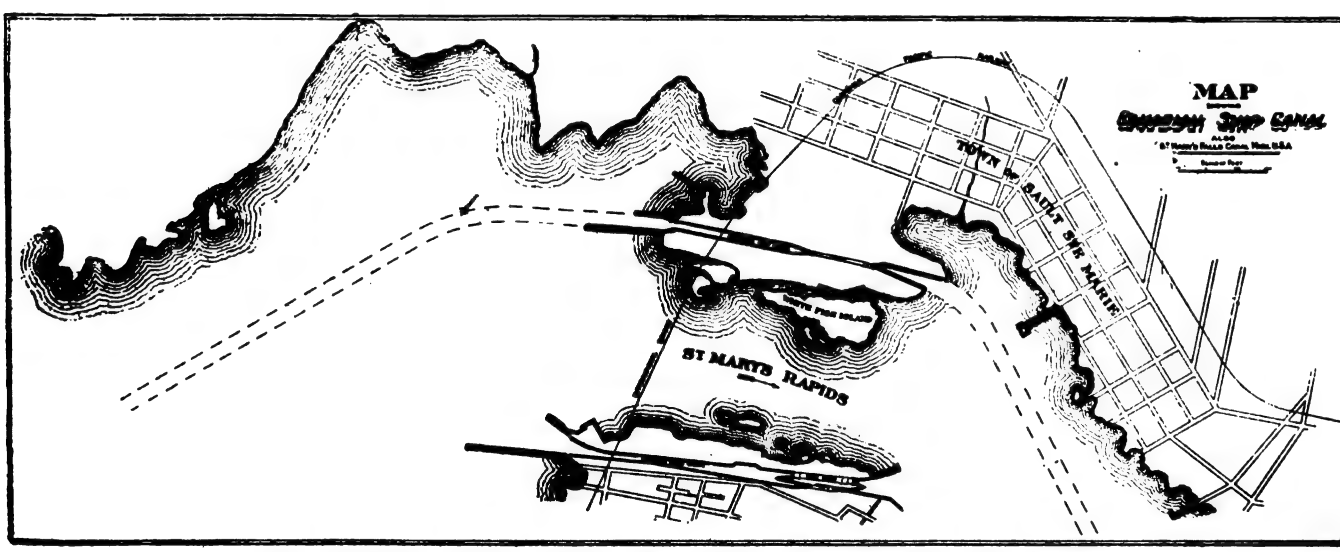
PLAN SHOWING LOCATION OF ARC LAMPS, SAULT STE. MARIE CANAL AND LOCK.

UTILIZING THE KERN RIVER FOR LOS ANGELES—105 MILES.

A survey was begun recently for the transmission line over which the Kern River and Los Angeles Electric Power Company proposes to convey the power of Kern river by electricity. The horizontal distance from the power house site on Kern river to a point on the north line of this city near Ivanhoe is 105.4 miles. The distance measured up and down hill over the slopes of the country traversed, as the line would be built, is exactly 108½ miles.

Commencing on Kern river about 10 miles below Kernville, the line passes close to Havilah, the old county seat of Kern county, crosses the Southern Pacific at the town of Tehachepi, touches the west end of Elizabeth lake, crosses the Soledad cañon near Lang's station on the Southern Pacific, debouching on the San Fernando valley near the mouth of the Little Tejunga. The highest altitude reached is 6,500 feet, near Tehachepi. The most difficult work is between the Soledad cañon and the San Fernando valley. Taken as a whole the difficulties of construction are few and readily surmountable.

The survey is now being used as a basis on which to estimate the cost of a line to transmit 10,000 horse-power as a starter, with facilities to increase hereafter to four times that power. Other surveys are being proceeded with to accurately determine all data connected with the hydraulic work on Kern river, in connection with which, it is said, there will be very few engineering difficulties.



MAP SHOWING CANADIAN SHIP CANAL, AND ST. MARY'S FALLS CANAL, MICH.

THE BUFFALO-NIAGARA FRANCHISE.

The Niagara Falls Power Company has conditionally accepted the franchise offered it by the city of Buffalo. The important conditions of the acceptance are that the requirement of a 5 per cent. payment of gross receipts to the city be reduced to 2½ per cent., and that the clause of the franchise involving forfeiture, when the company is declared by the Common Council to have violated its agreement, be replaced by a cause stipulating forfeiture only after thirty days' notice of "wilful and unreasonable violation."

TELEPHONY.

AN ENGLISH VIEW OF LONG DISTANCE TELEPHONY.

REFERRING to our article on "The Growth of Long Distance Commercial Telephony," appearing in our Aug. 28 issue, the London *Electrician* makes the following comments: Some particulars which we publish to-day from the columns of the New York ELECTRICAL ENGINEER relating to the growth and prospects of long-distance telephony are of special interest to this country just now, where a system of trunk lines for telephonic purposes is being inaugurated upon an extended scale and under Post Office control. We cannot adopt all the deductions which our contemporary draws from the statistics it is able to furnish with regard to the relative use of the telephone and the telegraph; still less can we admit that there is any likelihood of the former displacing the latter to any serious degree in popular favor in countries like England and America. Nevertheless, it may be admitted that for a considerable number of commercial requirements the telephone is a rival which the telegraph cannot afford to despise. That this fact was realized so long ago as 1879 by the Western Union Telegraph Company, who demanded and obtained 20 per cent. of the earnings of the Bell Telephone Company as a consideration for not entering into litigious opposition to the then new-born competitor, speaks well for the foresight and business capacity of the older Company. And that its young competitor has gone on prospering in spite of this heavy burden upon its profits is a very complete justification from the business point of view of the corresponding tax placed upon telephone operations by the Post Office in this country. The commission under this head paid to the Western Union Telegraph Company already amounts to one and a half million sterling; a corresponding commission paid to the Post Office, with an unquestionable monopoly, which the American Telegraph Company never possessed, is, therefore, not the extortionate imposition that it has been sometimes represented to be.

We have said that we do not implicitly accept the deductions of our electrical contemporary; and the more we look at the figures the less able are we to accept its conclusions. That there are ten times more telephonic messages than there are telegraphic messages is an interesting fact for the telephone companies, but as most of the former are urban communications of the speaking-tube order we are still left in complete ignorance as to the probable proportions of interurban or long-distance messages that are or will be transmitted by telephone when that system is developed to its utmost limits. It seems to us that its employment will, in a manufacturing country where *la petite culture* is almost unknown, always be confined mainly to commercial transactions of a very special character, and that for general purposes the telegraph must always continue to be the chief means of communication. The difference between them is very like that between a personal interview by appointment and the despatch of letters through the post. The telegraph has not reduced the business of Her Majesty's mails, and we do not believe that long-distance telephony will materially diminish the business done on long-distance telegraph wires.

THE TELEPHONE IN PARIS.

Government purchase is evidently no panacea for telephone troubles. M. André Lebon, Minister of Commerce and Posts, announces, says the Paris correspondent of *The Times*, "some improvement in the telephone system for next January, but the deficit is pleaded as an excuse for not as yet reducing the subscription in Paris, which is heavier than in other large cities. The possibility of increasing the revenue by lower rates and more subscribers does not seem to be considered. We must, therefore, be thankful for such small mercies as a reduction from 50c. to 25c. for a three minutes' conversation in Paris, a reduction from 160fr. to 50fr. for a subscriber's supplementary wire, and the abolition of the surtax on clubs and restaurants."

VERY PRIVATE TELEPHONES IN NEW YORK CITY.

There are some very aristocratic telephone owners in the city says the *New York World*, but a study of the telephone directory supplied for the use of the general public does not reveal this fact. This is done purposely. It is no use getting mad if, when you ask for Mr. Croesus Vanderbilt's telephone number the girl at the other end asks you if you don't know it. When you say that you don't know it or try to fool her and say you did have it but lost the memorandum, she will answer back. "We cannot give you Mr. Croesus Vanderbilt's house unless you know the number."

The fact of it is the girl would be breaking strict rules of the company if she gave this information. There are a good many millionaires and prominent society families who have telephones in their residences, but they are for private use. Only the friends of the head of the house and a few other persons know the number. The mistress of the mansion leaves the number with her friends, and in exchange receives their numbers. She also leaves her number with the head of the hospital where she happens to be on the Managing Committee.

This exclusive system is adopted in order that outsiders cannot annoy Mr. Millionaire by ringing him up on the telephone. The men who have telephones put into their palaces do so with the proviso that their names and telephone numbers shall not appear in the directory.

TELEPHONIC ACTIVITY AT JACKSONVILLE, FLA.

The Jacksonville Telephone Co. has been incorporated with a capital stock of $100,000 by W. N. Shine, A. H. King and C. B. Collins. Mr. Shine is the editor and proprietor of the *Weekly Floridian* of Tallahassee. An ordinance has been passed by the city of Jacksonville granting the company permission to operate a telephone exchange, on payment of 1 per cent. of the gross receipts for 10 years; and 2 per cent. for the next 10 years; besides furnishing 10 telephones free to the city. The rate to be charged subscribers is not to exceed $30 per year. Construction was to begin in 90 days from the passage of the ordinance, Sept. 3, and the exchange is to be in working order in 6 months with 100 instruments connected, or the franchise is to be forfeited.

ELECTRIC LIGHTING.

THE SUPERIORITY OF ALTERNATING OVER CONTINUOUS CURRENT FOR INCANDESCENT GLOW LAMPS.[1]

BY C. J. ROBERTSON.

IT has for some time been an established fact that with continuous currents there is a difference of potential in the vacuous space between the two conductors of an incandescent electric lamp. The experiments of Edison, Preece, Fleming and others, have conclusively shown this phenomenon, which is now generally called the "Edison effect." Besides this effect there can also be observed, especially at very high incandescence, a glow at the inner negative pole or conductor (generally called mount) of a glow lamp. The extent of this depends upon the state of, and the residual constituents in, the vacuous space, the amount of voltage, the degree of incandescence, and the width of separation of the two conductors inside the lamp. This apparently static glow can be changed from one mount to the other by simply reversing the polarity of the continuous current. I find the greater part of these glowings are caused by residual hydrogen remaining in the bulbs from various causes; such as the platinum wire being heated by the glassblower's hydrocarbon flame, the nature of the preparation of the filament, and the imperfect dryness of the residual vacuous space; all causes of these glowings.

Hydrogen and other gases are very observable at the negative pole, and are found there from what must be an electrolytic separation of the residual gases.

Recent experiments that I have made in the course of the manufacture of lamps, and special experiments, all confirm my first belief that each of these effects must be indicative of, or causes of, deleterious changes going on in the lamp. The natural sequence was to try these experiments with alternating currents, and the result is that the first effect, "Edison effect," vanishes, and the second, "static glow," cannot be obtained with alternating currents, except that there is an indication at excessively high voltages, and this is then seemingly an electrical evaporation. Also with alternating currents, the tendency of the lamp to suddenly short circuit (or to explode, as it is often called) is greatly diminished, and is almost impossible in ordinary practice and with good lamps.

Another beneficial effect of using alternating currents is, that with capped (plastered) lamps there are no electrolytic effects set up between the plaster and the metal parts of the cap, which is especially liable to occur with continuous currents, and with lamps in damp climates or situations. In the case of lamps installed under either of the latter conditions and fed by continuous current, there is a gradual lowering of the insulation resistance of the cap, and this is a plentiful source of premature breakage of the lamp, or at least the destruction of the cap.

The following experiments, which I carried out on a very large scale, that is to say, with many successive tests on about 30,000 lamps, completely showed the superiority of alternating over continuous currents for glow lamp lighting.

Whilst managing a large glow lamp factory in Vienna, I commenced a system of "up-keep" ("pauschal") for a fixed price per lamp per 1,000 burning hours. In this price was included the finding of the original lamps, the lamp renewals, and the payment for the current used by the lamps. This system is only

1. From the London *Electrical Review*.

commercially possible when one first knows the following points:—

1. The most economical efficiency at which to run the lamps at each installation, this being based on the prices of current and lamps and their duration at various efficiencies.

2. The average life of the lamps at these most economical efficiencies.

3. The mean amperes or watts taken by each class of lamp during its life.

4. The total watt or ampere hours indicated on the customer's watt hour or ampere hour meter.

Having three or four, one is independent of how long or how many of the total lamps installed are burned during each 24 hours, etc.; for these, of course, always provide the total average lamp hours or burning hours. To obtain 1 and 2, I carefully photometered and numbered each lamp, the results being entered in a separate book for each installation. Twice the installed number of lamps (preferably all of one candle-power, or, at least, of a fixed proportion of 8, 16 and 32 C. P. lamps) were initially supplied to each customer. After the first 100 hour period, all the original lamps of each installation were taken down, and reserve lamps were installed. The former lamps were returned to the works, where they were re-photometered, and the results entered in the special books. In this way the whole of the lamps were treated for each successive period of 100 hours, and the tests were continued until the whole of the 30,000 lamps were used up. Those lamps which had lost more than 20 per cent. of their candle-power were considered broken, and were not returned to be re-run. All these experiments were made on lamps of 2 and 2½ watts per candle, which were the most economical efficiencies for the various sizes of installations, owing to the charges for current being subject to large discounts for large consumers.

It so happened that about half of our customers were supplied with alternating current, 110 v. at 83 ~, from the mains of the International Electric Company (Ganz & Co.'s system,) and the remainder were supplied with continuous current from the mains of the Austrian General Electric Company (Siemens and Halske's system) at 110 v. The results of all these tests proved that the lamps on the alternating circuits broke less and retained their original candle-power better than those on the continuous current circuits, notwithstanding the fact that the variations of pressure on the alternating circuits were 7 per cent., and those on the continous were only 5 per cent., and also notwithstanding the fact that the duration of the maximum voltage was greater with the latter. These voltage tests were made both with recording instruments, and by numerous separate tests on the various consumers' premises.

THE NEW ADAMS-BAGNALL (A-B) ARC LAMP.

About May 1 there appeared in this journal at some length an account of the formation of the Adams-Bagnall Electric Co., of Cleveland, Ohio. We intimated at that time that as far as we knew no electrical company had ever been organized better equipped with specialists.

Since this announcement the company has been steadily at work getting out its new arc lamp which we are now able to illustrate in the accompanying engraving. The term "arc lamp" has always seemed to carry with it an idea of ungainliness,—a device having little form or shape, and strung out over 45 to 50 inches of space, divided up into sections of chimneys, rods, globes and sheet iron drums. In strong contrast to this is the "A-B" arc lamp as it is called, which is only 32 inches long over all and burns from 14 to 18 hours. It is a single carbon lamp with only one side rod, which causes one shadow only to be thrown. This shadow can be taken care of against the pole or building, leaving the light intended for the street entirely unobstructed.

A valuable feature about the operation of the lamp lies in the cutout. It is well known that there are some standard lamps on the market which operate and cut out perfectly at any reasonable number of amperes, provided the lamp has been previously adjusted for that number of amperes. The "A-B" lamp will operate and cut out perfectly at any number of amperes from 5 to 10 without any adjusting whatever. This valuable feature renders it feasible and easy for the station manager to run either 1,200 or 2,000 candle power lamps as suits his convenience, with the change of nothing except the ampere output of his dynamo. Since the invention of the cut out itself some 20 years ago, probably no step in its development has been of such importance.

Second only to the above mentioned feature is the fact that the series lamp can be changed instantly into a constant potential lamp and that again into an alternating lamp by simply an exchange of spools. All of the working parts of each lamp are mounted on one frame which is attached to the lamp casing by a single bolt and nut. By loosening this nut the working parts of one style of lamp are removed and those of another substituted. One style of lamp only need be carried in stock by the station manager and with the addition of several kinds of spools he will be prepared to furnish a lamp for any kind of circuit.

The "A-B" lamp is furnished in any style,—black japanned, yellow brass, oxidized copper, oxidized brass, 17th century brass, oxidized silver and aluminum. This provides an arc lamp good enough to hang up in a parlor, it being possible to match any

"A-B" Arc Lamp. About One-Third Actual Size.

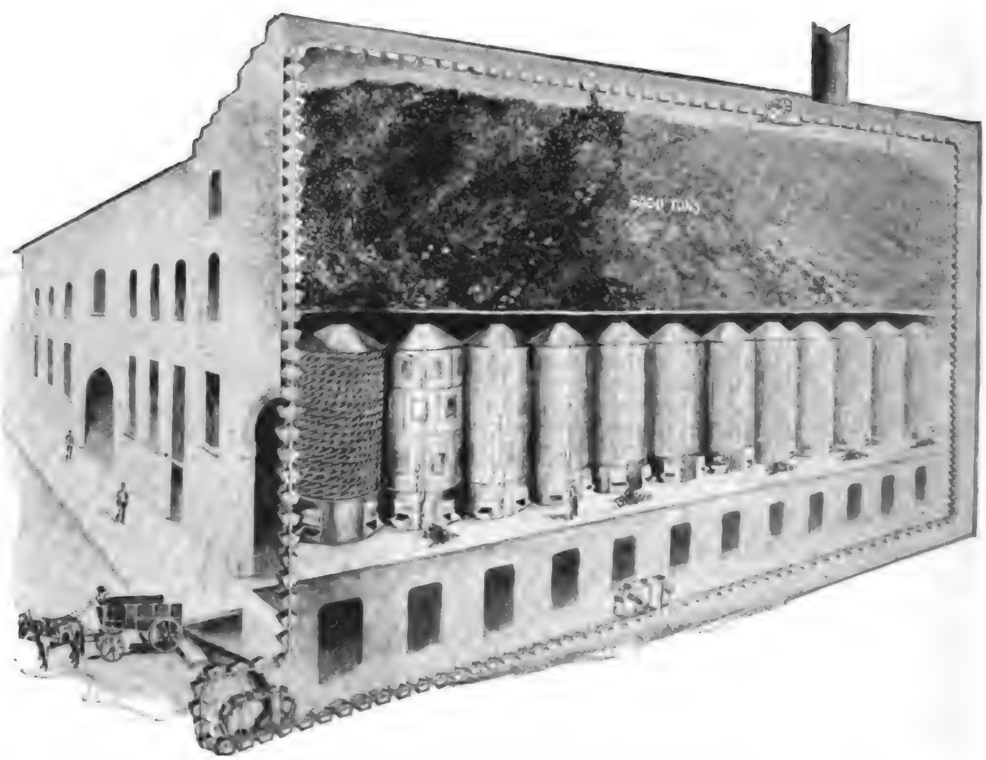
style of gas fixture or decoration. The casing being of cast iron makes the lamp look solid and gives the ornamentations on it a dignified substantial appearance very different from the brass and

sheet iron spun work usually adopted where ornamentation on an arc lamp has been attempted.

The "A-B" lamp is the direct result of several months of close study and application by the engineering corps of the Adams-Bagnall Electric headed by T. E. Adams, so well known in the arc lamp industry. The results obtained point to a lamp which cannot fail to take its stand at once among the leading lamps of the day, which assuredly means success for the new company. The officers of the Adams-Bagnall Electric Co. are as follows: Chas. G. Hickox, president; Geo. W. Howe, vice-president and treasurer; L. H. Rogers, manager; S. E. Cox, secretary; C. W. Phipps, superintendent.

HUNT COAL AND ASH CONVEYERS IN THE NEW STATION OF THE UNITED ELECTRIC LIGHT & POWER CO., NEW YORK.

The United Electric Light and Power Company, of New York, has erected and is now rapidly equipping an electric light and power station on 28th street, near the East River, which, when completed, will have a capacity of 19,200 horse power. One-half of the station is built on a lot 98½ feet wide by 161 feet long, and combines with the great horse power the large coal storage capacity of 3,000 tons. In this part of the station there will be 8 engines of 1,200 horse power each, and each supplying 10,000 16-candle power lights. The current used is the two phase and the generators will be run in parallel. The brick foundations for the engines and generators alone contain 1,200,000 bricks, each foundation being separated from the other. An electric crane, capable of handling 25 tons, is carried over the engine room.



Hunt Coal and Ash Conveyer in The New Station of The United Electric Light and Power Co., New York.

As the station is not situated on the water front the handling of coal and ashes presented quite a problem, which was solved by the employment of a conveyer system installed by the C. W. Hunt Co. The coal is received in wagons as shown in the accompanying engraving and dumped into the hopper under the sidewalk, and carried by the conveyer to the top of the coal storage building, over the boilers. This storage bin is so constructed, that all the coal will run to the boilers, and the plant is equipped so that at any time an approved design of stokers may be used. On its return, the conveyer runs under the boilers, and the ashes are drawn into the same conveyer that handles the coal, and carried to an ash tank from which they are removed at will.

On Oct. 4, a flywheel in the electric light plant at Homestead, Pa., flew asunder, one piece killing the engineer in the station, and other pieces being hurled hundreds of feet. Damage to the extent of about of $8,000 was done, and the plant was shut down for some days, pending the arrival of a new wheel.

RAILROAD LIGHTING AT MERIDIAN, MISS.

A special dispatch from Meridian, Miss., says: Quite an extensive electric light plant is now being placed in the shops of the Northeastern railroad company, which is designed to supply the entire Queen & Crescent system at this city, from the point of convergence of the N. O. & N. E. and A. & V. roads on the south to the crossing of the A. G. S. & M. & O. roads on the north, covering a distance of about two miles with electric lights. The dynamos are now being placed in position, the poles along the route are being erected, and it is contemplated that within thirty days the entire route indicated will be made almost as bright as day, even on the darkest nights, by a splendid system of electric lights. The shops, the yards, the railroad crossings, freight offices, union passenger depot, etc., will be brilliantly lighted, and the people of Meridian generally, as well as the traveling public and employees of the railroad, will appreciate greatly this further manifestation on the part of the company to provide every facility that will insure a safe and expeditious handling of its large business.

THE CRANDAL SIGNAL SYSTEM FOR SHIPS.

At the New York Navy Yard a special investigating committee has just reported favorably on the Crandal electric signal. This new system of signaling is so simple that it is easily understood, and any intelligent man-of-war's man can operate it with ease. It can be used at night in place of the torch and lantern of the wigwag code, which requires special instructions. The keyboard is composed of twenty-eight keys and the letters of the alphabet take the place of the flags and pennants of the commercial code. Each of these keys when pressed down closes the circuit in the several sections necessary to represent the letter or character engraved upon it, permits the passage of the current through the lamps in that section lighting the latter, and represents the letter desired. The letter is obliterated by the release of the key, which returns to its normal position, and the circuit is opened and the lamps extinguished. The monogram by which the signal is made and the keyboard are united by wires and cable connections with each other and with the electric battery.

CANADIAN PRAISE OF THE DATA SHEETS.

Mr. H. C. Champ, of Toronto, Ont., says: "These Data Sheets are really a very useful publication, and must fill a long-felt want. I look forward so much for them weekly, that I wish they would come out more often." Mr. P. G. Gossler, of Montreal, writes: "In regard to The Electrical Engineer Data Sheets I think they are a good and useful idea and shall be glad to furnish any information for this series that I am in a position to give you." From Berlin, Ont., Mr. E. Carl Breithaupt writes: "These Sheets are an excellent idea, and save us much trouble and time."

MISCELLANEOUS.

ELECTRIC FURNACES AND THEIR APPLICATION TO THE TRANSFORMATION OF CARBON INTO GRAPHITE.[1]—V.

BY CH. STREET.

(Concluded.)

Given the same current and rate of translation, the rate of transformation of any carbon into graphite varies with the mixture of which it is made. A carbon made with gas retort coke and tar is not converted into graphite to such an extent as one containing 2 per cent. of silica or 2 per cent. of boric acid. A similar result is obtained with powdered iron mixed with gas retort coke in the same proportion.

The nature of the medium appears to have but little influence on the tendency to transformation. Carbonic oxide, nitrogen, bisulphide of carbon, give similar results. Hydrogen alone would appear to slightly aid the change.

When carbons are subjected to this baking process the foreign matter they contain is volatilized or transformed into carbide, having a very high percentage of carbon and very difficult to attack with acid. The carbons obtained by this process possess very interesting new properties. The electric conductivity is augmented in the ratio of 1 to 4; the thermal conductivity increases in the same ratio. Finally, the resistance to combustion is considerably increased, as well as the resistance to fused alkali. The density of an ordinary 14 mm. carbon was found, before treatment in the electric furnace to be 1.98, and that of the same carbon after passage through the furnace was 2.6, the proportion of carbon transformed into graphite being 85 per cent. The density of a 25 mm. carbon after passage through the furnace was found to be 2.36, the proportion of graphite being 80 per cent. These differences depend upon the strength of the current, the speed at which the carbon is passed through the furnace, and the amount of carbon concerned. The proportion of graphite was determined by analysis by Berthelot's method, the main features of which I may be permitted to sum up. The carbon to be investigated is reduced to an impalpable powder, and then mixed with five to six times its weight of separately pulverized chlorate of potash. The material is then thrown, in small amounts, into fuming nitric acid so as to obtain a sort of paste. After the material has been left for a few hours, it is heated gently in an open vessel at 50° C. or 60° C. for three or four days. The material is then washed in water to eliminate the potash salts. This series of operations is renewed five or six times in order to completely dissolve the amorphous carbon, and to transform the graphite into graphitic acid.

The peculiar properties of these new carbons enable us to employ them with advantage as carbons for arc lamps, as anodes in electrolytic operations, and as dynamo brushes. When used as the positive carbons of arc lamps they wear away half as quickly, other things being equal, as ordinary carbons. Used as anodes these carbons behave in an altogether extraordinary manner, whether for electrolysis by the wet way or by the way of fusion. The ordinary artificial carbons rapidly disintegrate, crumble, and render all industrial use of them impossible, owing to the necessity of having to unmount and remount the electrolyzers at extremely short intervals. In the particular case of the electrolysis of the metallic chlorides the results obtained are perfect. Unfortunately we cannot give you many commercial results, the use of our carbons for this purpose being, as yet, in the experimental rather than in the commercial stage. Nevertheless, we can give you some figures which have been given to us by Mr. Greenwood, the inventor of the electrolyzer, exploited by the Caustic Soda and Chlorine Syndicate of London and intended for the production of caustic soda. Mr. Greenwood's electrolyzer is composed of a series of vats arranged in cascade. Each vat is divided into five compartments, each compartment forming a unit electrolyzer. Each of these units contains an iron cathode and a carbon anode constructed in a special manner, the electrodes being separated by a porous diaphragm, which is an important feature of the invention. This diaphragm consists of a rectangular frame supporting a series of V-shaped troughs arranged so that the lower point of the V enters into the groove of the one immediately below it. These channels are of glass or slate, and are filled with fine Canadian asbestos. This arrangement enables Mr. Greenwood to obtain a porous diaphragm of low resistance, and to effectually separate the chlorine liberated in the anode compartment from the product of the cathode compartment, since owing to the interlacing of the V-shaped elements of the porous partitions they present a path which it is impossible for the chlorine to take, owing to its density. The anode is constructed in the following manner. A certain number of carbon plates are coppered on one side, then tinned, and then placed side by side in a mould so as to form one large plate. In order to unite the constituents of the plate, an alloy of lead and antimony is run into the mould, so that after solidification one obtains a set of carbon plates secured in a skeleton-like metallic frame. This skeleton, and the joints covering the plates, are covered with an insulating cement, unattackable by acids. Moreover, the carbons are dipped in paraffin wax in order to stop up the pores and prevent the electrolyte from getting into contact with the metal at the back. When these anodes are constructed with ordinary artificial carbons they become, after a few days in the vats, quite useless, the carbon crumbling into dust. Mr. Greenwood has fitted a certain number of his electrolyzers with electro-graphitic carbons, and that about 15 months ago. From that date until now the apparatus has been in constant use, and the anodes do not exhibit any perceptible wear. The current densities employed have varied from 100 to 1,000 amperes per square metre of anode (9 amperes to 90 amperes per square foot). On several occasions greater current densities have been employed without in any way injuring the anodes.

We are of opinion that these carbons will contribute largely to the development of industrial electrolysis, seeing that they bring within the region of industrial practice numerous processes which up to the present have remained of a purely laboratory character. The high electric conductivity of these electro-graphitic carbons, and their perfectly homogeneous texture, which causes them to resemble cast material, should recommend them to the special attention of electricians with a view to their use as dynamo brushes. Ordinary carbon brushes possess, generally speaking, many advantages, some of which are: suppression of sparking, the possibility of allowing the machine to rotate in either direction without altering the position of the brushes, preservation of the commutator in a good state. The advent of electro graphitic carbon brushes will permit of the extension of the employment of brushes of this type to machines, which by reason of their construction or conditions of working could not hitherto make use of other than metallic brushes. Moreover, the peculiar character of the carbon of these brushes results in an extremely small coefficient of friction, and they do not unduly foul the commutator; they further enable us to obtain high conductivity at the point of contact between the brushes and the commutator. MM. Sautter-Harlé have found that electro-graphitic brushes can stand a current twice as great, other things being equal, as that which has been found dangerous for ordinary carbon brushes.

We are endeavoring at the present moment to adapt our electrical furnace to the making of incandescent lamp filaments, and we shall hasten to inform you of the results obtained in this direction.

In concluding this communication, I have to thank, in the names of M. Girard and myself, Mr. Frederick Maquaire, who has superintended the construction of the various type of furnaces, and M. André Tonnard, head of the laboratory of the Société le Carbone, who has superintended with the greatest possible devotion experiments often delicate and sometimes dangerous.

REPORTS OF COMPANIES.

REORGANIZING THE DETROIT ELECTRICAL WORKS.

The committee on the reorganization of the Detroit Electrical Works recommends the formation of a syndicate to raise $50,000 to purchase the assets of the company and $100,000 working capital. It proposes a new company with $400,000 non-assessable stock and $100,000 bonds. Each certificate holder may subscribe to the purchasing fund at rate of $4 for each $1 subscribed, providing he takes also one-tenth of the amount of the certificate in bonds at par. Stockholders and others may subscribe for any amount of bonds, receiving par in such bonds and 75 per cent. in stock. In case of over subscription shareholders have the preference. The syndicate will be prepared to bid at any sale of assets formerly owned by the Detroit Electrical Works. In case of purchase the syndicate will form a corporation, with the above mentioned capital stock and bonds, selling to such all the said assets for a portion of its capital then to issue. In case of a non-subscription to the purchasing fund, the syndicate may use such portion of the fund derived from bond subscriptions as may be necessary in consummation of the purchase. As soon as enough is subscribed to the funds to insure success the subscribers will be notified of selection of some bank or trust company as depository. The committee suggests that subscriptions to working capital fund be limited to $2 for each share of the old company.

EDUCATIONAL.

CATHOLIC UNIVERSITY, WASHINGTON.

Professor D. W. Shea, who has been the head of the College of Electrical Engineering at the Champaign (Ill.) University for the past three years, has resigned to accept the chair of physics in the Catholic University of America at Washington, D. C., where he will be at the head of the department of physical sciences and is expected to establish a college of electrical engineering. Professor Shea will leave for Washington as soon as arrangements can be made for carrying on the work of his department in Champaign.

LETTERS TO THE EDITOR.

THE MAGNETIC CAR BRAKE NOT DEAD.

I noted with not a little surprise the finale of your editorial in your issue of Oct. 2nd in reference to brakes on trolley cars, and must express myself not a little chagrined to note that in a journal devoted as yours is to electrical interests at large, and furthermore, I might state, in a discussion, a purely electrical journal—you should select air brakes as the one most applicable to electric cars. It is an honest truth that very little has been said in reference to electric brakes of late, but the interim has been one of great activity and progress in connection with the application of electric brakes to trolley cars. In this interval my system of braking has been entirely recast and adapted for use in connection with series parallel motors. While this has been found to be no easy task, the outcome is a matter for congratulation on all sides. Trolley cars with double motors will be equipped as they stand with braking machinery vastly simpler than any air brake could possibly be constructed, and with all the attendant advantages already recognized as possessed by the electric brake. For instance, with the electric brake there are no extra weights or strains whatever present in the equipment, thus saving a vast amount of wear in wheels and the entire wear of the brake shoes; the retardation being due to utilization of the stored energy of the car which it is desired to destroy, combined with the magneto induction effects already pointed out in connection with this apparatus.

The series parallel electric brake has been placed practically within the limits of the present series parallel controller; the same cables as are now employed, with the addition of a brake wire and a single handle serving to both run and control the car and operate the brake.

I hope it will be seen from the foregoing, together with the exhibits now being set up in Montreal, that substantial progress has been made in this important branch of electrical engineering within the last few months.

ELMER A. SPERRY.

NEW YORK CITY, Oct. 9, 1895.

WHY SOCKETS SHOULD BE STANDARDIZED.

I have noticed with interest your editorial on Standardizing Lamp Sockets. It would, indeed, simplify the matter of carrying in stock incandescent lamps, if there could be adopted a single standard socket, so that all lamps might be fitted complete and would not necessitate carrying so many different voltages and candle powers in stock. From the fact however, that there are now in use a large number of sockets of the Edison, Westinghouse and T.-H. type, it is almost impossible to adopt a standard socket, without considerable expense to the user of incandescent lamps. It will not be long before all of the sockets other than Edison, Westinghouse and T.-H. are replaced, and in replacing these sockets, we believe it would be beneficial to all concerned that they be replaced with either Westinghouse or Edison sockets, owing to the facts stated in your editorial that T.-H. bases cost the manufacturer from $7 to $8 a thousand more than Westinghouse or Edison.

While a standard socket would be most desirable if it was practical to adopt the same, we believe that if the attention of those installing new plants, was called to the fact that the T.-H. bases cost the additional amount and it was probable that from necessity the manufacturer would have to advance the price of incandescent lamps for this style of socket, it would lead them to discontinue the installation, in new plants, of T.-H. bases, and the adoption of either the Westinghouse or Edison, which would indeed very much simplify the matter.

Believing that your editorial will lead to this result, you should have the thanks of the entire trade for your timely article.

J. H. RHOTEHAMEL,
President.
COLUMBIA INCANDESCENT LAMP CO.

ST. LOUIS, MO., Oct. 5, 1895.

INSURANCE BOARDS AND HARASSED CONTRACTORS.

It seems that there is no limit to the opera bouffe methods employed by the Electrical Department of the New York Board of Fire Underwriters. The undersigned having become convinced that it was about time to call their attention *once more* to the lax methods of their inspectors in regard to rule 18, section B (which has always been violated) took certain steps to force an issue, as a matter of precedent. The steps as taken produced the desired result in a very short time, inasmuch as the contractor whose work was condemned by the undersigned, immediately sought redress of the New York Board of Fire Underwriters, stating that his work had been condemned by the undersigned because he had used Circular Loom tube where passing through floors, and claimed that he had a perfect right to do this as it always had been done, and passed by the New York Board through its various inspectors. The contractor was somewhat taken back by being informed by the chief inspector that the New York Board had never passed anything of the kind, and would not permit it.

The contractor was *correct* in his statement that it had been allowed by the New York Board of Fire Underwriters, and up to within the last few days the inspectors, as well as the chief inspector, did pass such tube under such conditions, although it was in violation of the rule as quoted above. An order has *now* been issued to the inspectors of the Board that the *rules of the Board must be obeyed*. This would strike the ordinary mind as the height of absurdity in this particular case, but fully within the usual line of procedure as laid down by this particular Board of Fire Underwriters in its attempts to show how little it really knows about the practical application of electricity to interior lighting, or to the proper interpretation of the rules as laid down by its own officials.

FREMONT WILSON, C. E.

NEW YORK CITY, October 5, 1895.

AN INTERESTING LONG ROAD FOR VIRGINIA.

The engineers are at work on the first link of our projected line from Basic City to Bridgewater, 25 miles, together with local street systems in both cities; also electric light and power plants. Other connections will follow as rapidly as consistent with our conservative plan of action, to such other points as show beyond question that the traffic will give us a paying line. We shall mainly be freight and passenger feeders to the lines now existing in the valley, and where such sections need means of transportation, which are difficult of access by the steam roads. We act under a Virginia state charter, with such local franchises as are necessary. No contracts have been let, and we are open to correspondence with parties supplying any and all necessary articles needed in our construction.

EDWARD P. WILSON,
Gen. Mgr. Basic City & Bridgewater Electric Ry.

BASIC CITY, VA.

SOCIETY AND CLUB NOTES.

CLEVELAND ELECTRIC CLUB.

The Cleveland Electric Club had one of the biggest gatherings in its history, at its annual meeting. The following officers were elected: Chas. W Wason, president; E. P. Roberts, first vice-president; J. P. McKinstry, second vice-president; H. J. Davies, secretary; E. W. Moore, treasurer; board of managers, Geo. M. Hoag, S. H. Short. Plans for the winter were discussed, and it was decided to have monthly instead of semi-monthly meetings, and to invite the public generally to attend. A better class of papers will be prepared and read at the meetings than heretofore, and a special effort will be made to interest the public in electrical matters.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION.

The above association is issuing circulars asking for suggestions as to needed improvements and changes in the rules that cover electrical installations. It will be glad to send a circular, to be filled up, to anyone interested. The meeting at which replies will be considered will be held on December 10. Mr. C. M. Goddard, secretary, may be addressed, 55 Kilby street, Boston.

LITERATURE.

Motive Powers and Their Practical Selection. By Reginald Bolton. New York, 1895. Longmans, Green & Co. 257 pp., 5 x 7. Price, $2.25.

This is one of the most practical works of its kind which has come under our notice for some time. The author has, indeed, condensed into small space a mass of information on the ever timely subject of power, to find which individually would involve long and tedious examinations of many works and periodicals. The seven sections into which the book is divided begin with the consideration of the general subject, the discussion of first cost, and then pass on to the available powers, which are divided into manual power, animal power, wind and water, steam, gas, oil and hot air engines, and finally the power of stored electricity. Each of these is thoroughly treated and individual chapters give, not only the most recent data on the sizes of engines, cost, efficiency, etc., but enter into all the details which are necessary in order to enable the engineer to arrive at a satisfactory basis for the determination of the most successful method of power to be applied in a given case. Short descriptions of

of machines treated of, even though not accompanied by illustrations, are most helpful. The chapter on the storage of power by electricity, and the re-use of the same, contains a number of interesting tables of details, and costs of electric motors, but the author seems to be in error on the price of the latter, so far as the figures at present ruling in this country are concerned. Thus he places the cost of an 80 H. P. machine at $2,250 ; that of a 20 H. P. at $750, and that of a 1 H. P. at $140. These sums are converted directly from the corresponding value given in English pounds. If these are the prices ruling in England we can beat English manufacturers by anywhere from 25 to 40 per cent. on prices; but possibly the author may have taken list prices without considering discounts. We notice, however, in another table that the prices given for dynamos and motors are more nearly correct, according to the ruling quotations. Throughout the work prices are given both in pounds and dollars, and this double designation, we are glad to notice, is gradually coming into vogue among English technical writers, to the benefit of readers generally.

There is scarcely a page in the book which does not contain some valuable hint or piece of information, and every engineer will find it a valuable book to have within reach.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED OCT. 8, 1895.

Conductors, Conduits and Insulators :—

Insulator Pin and Insulator, C. F. Carroll, Manistee, Mich., 547,660. Filed June 6, 1895.

A pin that has a sufficient length to pass through the cross-arm.

Distribution :—

Electric Car Lighting Apparatus, W. Biddle, Brooklyn, N. Y., 547,536. Filed Dec. 24, 1894

A peculiarly constructed dynamo, in which the bar or connection between the poles of the field magnets forms part of the inclosing case, so that the field magnets can be forged out of soft iron with great facility. Makes use of neutralizing field magnets at the sides of the armature.

Electric Car Lighting, W. Biddle and H. E. Dey, Brooklyn, N. Y., 547,537. Filed Jan. 9, 1895.

The combination in an electric car lighting apparatus, with the secondary battery and the lighting circuit, of a dynamo having two armatures and two sets of field magnets the helices of one set of field magnets being in circuit with the secondary battery, and the helices of the second set of field magnets in circuit from the brushes of the second armature, being in the main circuit of the secondary battery.

Phase Modification, H. A. Rowland, Baltimore, Md., 547,688. Filed May 19, 1894

Object of this invention is to vary the frequency of a polyphase current from zero to any desired frequency, as may be desired, to produce means for starting synchronous and other motors and causing them to run at different speeds and to accomplish with other translating devices a variety of other results of like nature. Employs brushes in contact with revolving commutators.

Electrometallurgy :—

Black-lead Machine. C. Schraubstadter, Jr. and C. R. Schilling, St. Louis, Mo., 547,456. Filed March 5, 1894.

Improved machine for coating with black-lead the molds of articles that are to be electrotyped.

Lamps and Appurtenances :—

Electric Arc Lamp, H. E. Bradley, Pawtucket, R. I., 547,659. Filed July 1, 1895.

Details of a clutch lamp.

Cut-Out for Arc Lamps, D. Higman, Boston, Mass., 547,758. Filed June 27, 1895.

The carbon rod has a groove which actuates a pawl to cut the lamp out.

Miscellaneous :—

Valve Controller, G. Hill, New Brunswick, N. J., 547,434. Filed Jan. 3, 1895.

Designed to open and close valves in response to circuit changes produced by a thermostat.

Electric Bicycle, H. W. Libbey, Boston, Mass., 547,441. Filed Oct. 9, 1894.

Details relating to construction of wheels, location of battery, etc.

Electric Key Action for Pipe Organs, E. S. Votey, W. B. Fleming and W. D. Wood, Detroit, Mich., 547,568. Filed Jan 21, 1895.

Time Controlled Electric Heater, L. E. Custer, Dayton, Ohio, 547,714. Filed Dec. 22, 1894.

The combination with an electro-receptive device or muffle, a rheostat, and mechanism actuated by clock work for throwing the various resistances of the rheostat successively into the circuit.

Railways and Appliances :—

Trolley-Track, A. Schumacher, Millington, N. J., 547,457. Filed Mch. 21, 1895.

An inclosed trolley track comprising a continuous U-shaped hood or casing, the rails secured to the continuous interior faces of the sides of the casing, thus leaving a central slot between the two rails.

Switches, Cut-Outs, etc.:—

Switch and Fuse Box, J. B. Smith, Manchester, N. H., 547,591. Filed Apl. 12, 1895.

Telephones :—

Telephone System, F. D. Shepard, Milwaukee, Wis., 547,460. Filed Feb. 18, 1895.

Details of circuit arrangements.

Telephone Switch, W. M. Miner, Plainfield, N. J., 547,613. Filed June 5, 1895.

An automatic lock which operates to prevent a movement of the switch to change the circuits from either one of its two positions until the lock or detent is removed by some act of the user.

Automatic Telephone System, G. K. Hutchins, Baltimore, Md., 547,755. Filed May 6, 1893.

The combination, in a system of the character described, with a primary switch, a pilot switch, and a station, of a single metallic circuit connecting the three, both wires passing through the pilot switch, whereby the movements of the primary switch are controlled from the station through the pilot switch.

LEGAL NOTES.

THE TESLA POLYPHASE PATENTS.

The General Electric Co. has been granted more time, viz., until Nov. 16, to file evidence in the suit of the Westinghouse Co. against it for infringement of the Tesla patents; and the plaintiffs have twenty days thereafter for cross-examination. The original limit was Oct. 7.

IS A TELEPHONE CO. A COMMON CARRIER?

The National Telephone Construction Company has filed papers in the U. S. circuit court at Milwaukee, against the Wisconsin Telephone Company. The plaintiffs allege that they have a long-distance telephone belonging to the Wisconsin Telephone Company in their office at Waukesha, and they allege the defendant company is seeking to remove it. They ask the court for an injunctional order restraining them from doing so.

THE THOMSON-HOUSTON REGULATOR APPEAL DEFEATED.—WESTERN ELEC. CO. VS. THOMSON-HOUSTON CO.

THE United States Circuit Court of Appeals at Chicago on Oct. 8, handed down, among others, an opinion adverse to the Thomson-Houston arc regulator. The Thomson-Houston Electric Company was the unsuccessful party in the suit. The action involved a device known as the automatic regulator, which, as to arc lighting, performs a function similar to that of a governor on the steam engine.

Suit was begun against the Western Electric Company, praying for an injunction restraining the defendant company from using the regulator and asking an accounting. The suit came to trial before Judge Grosscup in June, 1894. The court upheld the contention of the Western Electric Company that the second patent, which it was claimed was being infringed, was voided, because of the prior issue of the patent covering the device. An appeal was taken to the United States Circuit Court of Appeals, which affirmed Judge Grosscup's ruling.

SUITS FOR INFRINGEMENT OF UNDERGROUND ELECTRIC RAILWAY PATENTS.

E. E. RIES AND A. H. HENDERSON VS. THE METROPOLITAN TRACTION COMPANY OF NEW YORK, AND THE METROPOLITAN RAILROAD COMPANY OF WASHINGTON.

MESSRS. Elias E. Ries of Baltimore, Md., and Albert H. Henderson of Philadelphia, Pa., have instituted legal proceedings against The Metropolitan Traction Company of New York, and The Metropolitan Railroad Company of Washington, D. C., respectively, for infringement of certain letters patent relating to Underground Conduits for Electric Railways. The Bills of Complaint were filed in the Circuit Court for the Southern District of New York on September 17, 1895, and in the Circuit Court for the District of Columbia on October 3, 1895, respectively, through complainants' counsel, Messrs. Price & Steuart, and Mr. James Steuart, Solicitors.

It is alleged by complainants, in substance, that the electric conduit railway line recently constructed for The Metropolitan Traction Company and now in regular operation on Lenox Avenue, New York City, as well as the underground conduit railway built by The Metropolitan Railroad Company and in operation on its Ninth Street line in Washington, D. C., severally constitute a direct infringement and violation of certain basic letters patent granted to Mr. Elias E. Ries and owned by the complainants, covering essential features which are used in the construction of the roads in question, and upon which their practicability and successful operation depend.

The patents upon which suit has been brought and which it is alleged are infringed are seven in number, as follows: 338,556, granted March 23, 1886, conduit for electric and cable railways; 370,283, granted September 20, 1887, underground conduit for electric and other railways; 383,770, granted May 28, 1888, underground conduit and collectors for electric railways; 386,085, granted July 10, 1888, electric railway; 386,087, granted July 10, 1888; combined electric railway and wire conduit; 409,756, granted August 27, 1889, electric railway crossing; 409,755, granted August 27, 1889, underground conduit for electric railways.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE E. M. TRACTION COMPANY'S CONDUIT SYSTEM.

The E. M. Traction Company, of Philadelphia, has recently finished a fine factory for the manufacture of its system of underground electrical distribution, equipped with modern tools and machinery. Current is supplied by an Eddy generator, direct connected to a Ball engine. The E. M. Traction Company has also built and equipped a short but complete railroad, with nine-inch girder rail, Belgian block, asphalt and brick, to show the operation of the McLaughlin conduit system. The road is equipped with St. Louis cars, Peckham trucks and General Electric motors and the results show that the system is entirely operative.

The E. M. Traction Co. is to have as its representatives at Montreal, Messrs. J. F. McLaughlin and George Lodge, the general manager. They will also distribute, to whomsoever will, a pretty and appropriate tri-color badge.

GENERAL ELECTRIC AT THE CONVENTION.

The General Electric Company will make a good exhibit of their street railway apparatus at the Montreal Convention. Their headquarters will be at the St. Lawrence Hall and the exhibit will also be made at these headquarters. It will consist of the following apparatus: Two G. E. 800 motors mounted on a Peckham truck to be operated in connection with electric brakes by a B. A. Controller. Behind this will be placed a panel switchboard, consisting of one 3,000 and one 1.000 form K generator panels. One station panel fitted with 5,000 ampere form G-1" watt meter for measuring total station output; a 5,000 ampere illuminated dial ammeter; one form A and one form B feeder panels. Two section switches, one 4,000 ampere receptacle and one 6,000 ampere receptacle with fuses. They will also exhibit their triad of motors, consisting of the G. E. 800, the G. E. 1,200 and the G. E. 2,000, in connection with the controllers for operating each.

In addition supplies will be shown. The company will have 20 representatives on the ground.

"WAY UP" WESTINGHOUSE.

A General Electric man says: "What we really need in the electric field is an agreement with Westinghouse and higher prices for apparatus, but Westinghouse is a very difficult man to treat with. He is way up in the air, and won't come down."

BUYERS' HINTS.

Mr. A. O. Schoonmaker continues to carry a large stock of mica, India or amber. He can furnish any shape, size or pattern.

The Westinghouse Co. are introducing their new 50 H. P. steel motor. The parts are wonderfully accessible.

"The Proof of the Pudding is in the eating"—look at the curves in the Electric Storage Battery Co.'s "ad," this issue.

Carbons are a Necessity. Mr. Hugo Reisinger invites attention to "The Electra" brand and is glad to send samples.

Albert and J. M. Anderson are still in the field with their famous line material. They guarantee all their goods.

The Helios Electric Co. are advertising the only arc lamp with a reflector plate. Have you tried it?

The Okonite Company are "showing their hand." They have a long arm back of it.

A Commutator Compound that does the work, and "Insullac" (another good thing) are what the Electric Appliance Co. are talking about just now.

Electric Locomotives for Steam Roads is the subject treated of by the General Electric Co., in one of their "ads" this week.

McIntosh, Seymour & Co. make a specialty of engines for street railway power plants. They are in use in some of the largest stations in this country.

Generators and Motors made by the Eddy Electric Mfg. Co. are of standard quality and merit the investigation of intending purchasers.

A New System of distribution for the propulsion of street cars by means of underground conductors buried between the tracks is being advertised by the E. M. Traction Co. No slots to lose hard earned nickels in! No openings!

The Adams-Bagnall Electric Co. are selling an arc lamp that operates on a 1,200 or 2,000 candle power circuit without change. Some of them are finished in aluminum. It is a remarkable novelty.

The New Bedford Gas and Edison Light Co. are offering some engines, boilers and other apparatus at a bargain, to make room for larger units. It is a good sign when a company has to increase its facilities for doing business.

NEW YORK NOTES.

The Fowler Car Works at Elizabeth, N. J., owned by H. H. Isham have. it is stated, been sold to the Lewis Co. of Brooklyn which with $500,000 capital will make trolley cars there, employing 500 hands.

The Peerless Rubber Co. have opened an office at 970 Old Colony Building, Chicago, for their admirable specialties in Rainbow packing, etc., in order to meet the large and growing western demand. It is understood that no less a person than Mr. d'Evers himself will take charge, for the time being at least.

The Berlin Iron Bridge Co., of East Berlin, Conn., have just completed for the town of Hadley, N. Y., a bridge 300 ft. long and 16 ft. wide. The same company have also lately completed a new store room for the Hartford Rubber Works, a new car house for the Norwalk Tramway Co., at South Norwalk, Conn., and also a new generator house for the Burlington Gas Light Co., at Burlington, Vt. They report work as very brisk in all departments.

WESTERN NOTES.

Illinois Steel Rail Co.—The interurban street railroad between Bay City and Saginaw has awarded the contract to the Illinois Steel Company for $20,000 worth of the best steel rails.

The Sunbeam Incandescent Lamp Company of Chicago, has recently perfected a process for engraving on incandescent lamps and at a small additional cost is prepared to furnish lamps with any special design which may be desired. There has long been a demand for ornamental incandescent lamps, especially if they can be furnished at a small additional expense.

Munson Conduit Co.—The articles of incorporation of the Munson Electric Conduit company have been filed at Davenport, Ia. by John H. Munson, James E. Merritt and William F. Roberts. The business of the corporation is to acquire the ownership of the John H. Munson electrical railway patents, and to engage in the construction of electrical railways. The capital stock is placed at $10,000,000, and the company is to commence business at once. The incorporators are also made the board of directors until the first annual meeting next September and the corporation is to continue for a period of twenty years, $5,000 being the highest amount of indebtedness permissible.

PHILADELPHIA NOTES.

The Acetylene Light, Heat and Power Company, with a capital stock of $1,000,000, divided into 20,000 shares at $50, has perfected its organization and is now prepared to transact business at the office, 372-74 Bullitt Building, Philadelphia. This stock was offered for subscription at par last week and subscribed three times over.

T. A. Edison was in Philadelphia last week, the guest of Prof. W. D. Marks. It was rumored that his visit had something to do with the new Pennsylvania Heat, Light and Power Co., with a capital stock of $10,000,000, which has been heavily oversubscribed, and is understood to propose the use of storage batteries and to utilize culm. Mr. E. B. Ives has been appointed chief engineer; and the company is looking up methods of underground distribution.

Cope & Co., 8 North Sixth street, Philadelphia, have made great business strides with their new and ingenious "pilot line" machine for subway work, during the past year, having rodded over 1200 miles of duct, besides drawing in many miles of cable. We wonder that their work has not, indeed, been even larger, so useful and successful is their apparatus, as well as economical. Mr. T. J. Cope, the inventor, is now visiting the principal cities along the Atlantic seaboard and westward as far as Indianapolis, arranging for contracts with traction, electric light and other companies that have cables to be drawn in. It is a pity that he has not time enough to extend his trip into other sections of the country where underground work is going on, and where his help is decidedly needed.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

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MISCELLANEOUS.

THE WOOLF ELECTRIC DISINFECTING PLANT IN PHILADELPHIA.

We have in the past, on various occasions, referred to the remarkable powers, as a disenfectant, of Mr. A. E. Woolf's "electrozone," consisting of hypochlorites and other hypo salts, formed by electrolyzing sea water. Heretofore this product, in both the dilute and the concentrated form, has been used more particularly for medicinal purposes, in comparatively small quantities, and for domestic disinfection, although one or two plants have been installed in connection with hospitals; and our readers will also recall a like plant which was employed to purify the water of New York City, at Brewsters, N. Y., from which New York draws part of its supply.

The direct application of such a cheap method of producing a powerful disinfectant has naturally won the attention of health authorities of cities to the Woolf disinfecting process; and what may be considered to mark an epoch in the methods of maintaining the health of cities is the inauguration in Philadelphia of a Woolf electric disinfecting plant, under the auspices of the City Health Department.

The initial plant has now been installed, and is situated in the basement of the Public Building at Market and Broad Sts. It has a capacity for making 500 gallons of disinfectant every three hours. The current for electrolyzing the salt solution is taken from the lighting circuit of the building, and in order to reduce the voltage from 110 to six volts, which is that required for the purpose, an Excelsior motor is used, which drives directly an Excelsior dynamo, through a flexible leather coupling. The dynamo is capable of delivering 1,000 amperes at six volts. Two tanks, of 700 gallons capacity each, are employed, and the positive electrodes are of copper coated with platinum.

A connection runs from the electrolyzing tank, by which the disinfectant is pumped to a cart outside the building, a distance of about 200 feet, the cart being used to distribute the liquid wherever required. It is intended with this plant to disinfect the overground drainage in the thickly populated parts of Philadelphia, the liquid being distributed in sprinkling carts. A portion will also be at the disposal of the Board of Health for use in special cases of domestic disinfection.

WOOLF ELECTROZONE GENERATING PLANT IN PUBLIC BUILDING, PHILADELPHIA, OPERATED BY THE HEALTH DEPARTMENT.

The generating plant is in charge of Mr. J. C. Sager, chief of the Philadelphia Electrical Bureau. It was started on Oct. 1, when an inspection of the plant was made by the Board of Health, and several of the most prominent medical men in Philadelphia. Among those present were

Mayor Warwick; Dr. J. Solis Cohen, of the Home for Consumptives; Dr. P. D. Keyser, of the Willis Hospital; Dr. Beitler, Director of Public Safety; Dr. Ford, and other members of the Board of Health. Mr. Woolf, who was present by invitation, explained the process, and gave an exhibition of the power of the disinfectant in the destruction of germs of all kinds. The plant was formally accepted on Oct. 18, on which occasion Mr. Woolf delivered an address in the rooms of the Board of Health.

OPENING OF THE CARBORUNDUM WORKS AT NIAGARA FALLS.

On Friday, Oct. 19, the formal opening of the new works of the Carborundum Company, at Niagara Falls, took place in the presence of a number of invited guests, and thus was inaugurated a plant which will unquestionably rank among the most important that have thus far been attracted to the Falls.

Before entering upon a description of the work accomplished with the new equipment it may be of interest to relate the events which have led to the creation of the new carborundum works. It will be recalled that, prior to the starting of its Niagara Falls plant, The Carborundum Company manufactured carborundum at Monongahela, Pa., using steam power to produce the current, the daily

THE CARBORUNDUM WORKS, NIAGARA FALLS, N. Y.

output amounting to about three hundred pounds. Although the making of carborundum is now carried on only at Niagara Falls, the old plant is operated in making finished goods from the grain and powder carborundum sent from the new plant.

Owing to limited facilities heretofore existing, the production of carborundum had been so small, as to practically restrict its uses to the finer trades such as the dental and manufacturing jewelers', fine tool grinding, pearl grinding and kindred industries. The development in the dental trade especially, has been remarkable, and, in the form of discs, lathe and engine wheels and cloth finishing, carborundum is rapidly displacing all other abrasives in this important trade, not only in the United States but throughout Europe.

This development is also noticeable in the jewelry trades where in the form of wheels and powders it is used in polishing and grinding the delicate wheels, springs, etc. in the manufacture of watches. Its value is materially enhanced because of the fact that owing to its exceeding hardness, the finest, impalpable powders have remarkable cutting properties; and although no special effort has been made to introduce it into the glass grinding and finishing industries, its value as a superior abrasive for these purposes is recognized.

Its utility has been demonstrated in the more important grinding trades such as car wheel grinding, machine shop finishing and all other industries using large wheels; its rapid cutting qualities resulting in a saving of labor and time, a valuable consideration in any manufacturing interest. This large field has remained practically closed owing to the inability of The Carborundum Company to make a sufficient quantity of the material to manufacture wheels larger than twelve inches in diameter for the general trade, large orders being constantly turned away.

To produce carborundum at the lowest possible cost, and thereby permit of its general adoption as an abrasive for all classes of work, has of course been a subject of vast importance to The Carborundum Co., and after having investigated the possibilities of Niagara Falls as a manufacturing point, they determined to locate a plant in that city that they might have the benefits of cheap power from the Power Company and have also, the advantage of railway facilities there offered. A contract was made with the Niagara Falls Power Company, for 10,000 H. P. to be delivered as required for the purposes of their manufacture, and it is thought that the initial 1,000 horse power now being used, will be added to at an early day and with that in view the plant has been constructed to accommodate 3,000 to 4,000 horse power.

With this brief history, let us now follow the crude materials through the various processes to the state of finished product.

The various buildings and apartments of this superb plant are admirably arranged for the economical handling and manipulation of the materials. The stock building into which are received the crude materials, is provided with a railway track connecting with the Niagara Junction R. R., on which the loaded cars are conveyed to the various bins or compartments provided for the reception of the crude materials, which consist of coke from the Pennsylvania bituminous coal fields, white sand from Ohio, salt from the salt works of New York State and sawdust from the mills of Tonawanda. Conveniently arranged, in relation to the storage bins of crude materials, is a most complete grinding, grading and mixing plant, into which the coke as it come from the cars is introduced and ground and sifted into assorted sized grains and conveyed into bins, from which it is drawn and mixed in proper proportion, with measured quantities of sand, salt and sawdust, and these measured quantities thoroughly mixed and delivered in a bin provided for the finished mixture. This work is done by automatic machinery at the least expenditure of manual labor.

The four crude materials having been wrought into what is called the mixture, they are conveyed to the electrical furnaces situated in an adjoining building. It would, perhaps, be difficult for one unskilled in the arts of the electro metallurgist and unfamiliar with the apparatus he employs in producing his transformations, to recognize the rough, and apparently crude oblong brick boxes, made without cement, mortar or other binding materials, as furnaces. Provision is made for five of these furnaces, extending down one side of the large spacious building, each of them measuring about fifteen feet in length by seven feet in width and the same in height. In the centre of each end is placed a large bronze plate and these are connected by means of four large copper cables to massive copper bars extending under the floor at either end of the furnaces. Connecting with the inner-surfaces of the bronze plates are one hundred and twenty carbon rods, sixty to each plate. These carbon rods are three inches in diameter and a little over two feet in length, and they are so placed as to pass through the end walls of the brick furnace, projecting into the interior and towards each other, thus constituting the terminals. Into this furnace the mixture that has been prepared in the stock rooms is introduced, about ten tons constituting a charge; and through the centre of the mass of mixed materials is placed a core or cylinder of granules of crushed coke extending from the carbon rods at one end of the furnace to those at the other end, and making a perfect electrical connection through

the furnace by means of the bronze plates, carbon rods and the core.

The furnace, as above described, is prepared for the turning on of the current and this is provided for and controlled in the adjoining building which was specially constructed for the transforming apparatus used in reducing the high pressure current as received from the dynamos of the Niagara Falls Power Company, to the low pressure current used in the electric furnaces. Located in the same building is the regulating apparatus used in controlling the current as it passes to the furnaces.

When everything has been properly prepared, the connections to the furnace are completed, and 1,000 horse power of electric current is turned into the granular core, above referred to, and kept on for twenty-four consecutive hours, making a total expenditure of energy of 24,000 horse power hours. All of this vast amount of energy is transmitted to the core—twenty-one inches in diameter and about nine feet long.

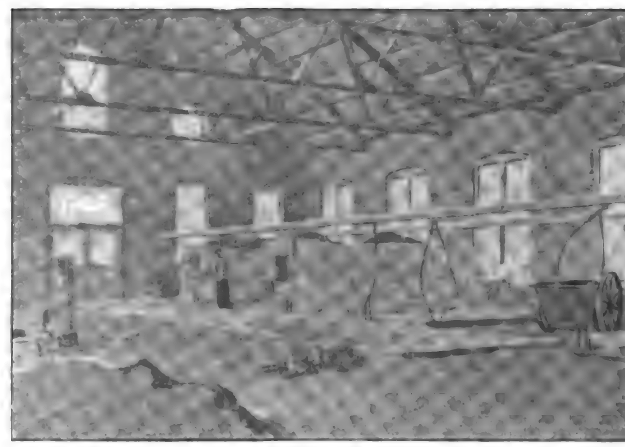
About two hours after the turning on of the current, gases begin to escape through the crevices of the brick walls of the furnace and being ignited they burn with a lambent blue flame. As the process continues, the outer walls and top of the mass in the furnace show a slow rise in temperature, the effect of the transmission of the intense heat from the core, the entire top of the mass becoming red hot in about 12 hours. After the current has remained on for the period of twenty-four hours, or until such time as the workman in charge recognizes that the process is complete, the current is stopped in the transformer building, the flexible cables are disconnected from the bronze plates and others are connected with the plates of the next furnace in the series of five, and it in turn is carried through the same operation.

Interesting as thework may have been up to the point of stopping the current, it cannot compare with that at the moment of opening a furnace. One end of the furnace is removed and a cross section through its centre

A Carborundum Furnace.

exposed, thus permitting of a ready inspection of the result of the operation. In the centre is the granular core, in the same position in which it was originally placed, but it is now purified of all foreign substances. It is now pure carbon and has lost about one-fourth of its weight, this loss representing the volatilized impurities. The presence of grains of graphite disseminated throughout its mass indicate that its temperature must have been near 7,000 degrees, which is the point of graphite formation. Surrounding the core, in the form of a cylinder, is a beautiful crystalline formation, the crystals being constructed on lines radiating from the centre. Those crystals in immediate contact with the core are looped or built together into one concrete mass, this solid formation giving way to a loose structure, as the distance from the core is increased; the size of the crystals, at the same time, diminishes rapidly, until at about 15 inches all crystallization ceases and is followed by an amorphous material, of a whitish gray color, for a distance of about 2 inches, when a sudden change occurs to a black mass composed of the original mixture, now held together in a cemented state by the fusion of the salt.

The crystalline and amorphous material lying between the core and the outer black mass, is carbide of silicon, being composed of carbon and silicon, atom for atom. It is this material that was discovered by Mr. Acheson and by him called carborundum. About two tons of carborundum is produced in one furnace run, and to prepare it for the market it is first passed under heavy iron rolls, for the purpose of crushing apart and separating the individual crystals, after which it is treated with an acid and water bath to remove all solubles. It is then dried and sifted, to separate the various sized grains, and placed in bins



Interior of Furnace Room, Carborundum Works.

ready for packing for shipment, or to be worked up into wheels, hones, or other forms in which abrasives are used.

At the opening the guests were welcomed by Mr. E. G. Acheson, the president of the Carborundum Co, and inventor of its process of manufacture; and to whose energy and ability the present excellent position of the company is principally due.

ARGON.

An examination of the gases liberated, says *Nature*, from certain of the sulphurous waters of the Pyrenees reveals, in the hands of M. Ch. Bouchard, the interesting fact that the formerly assumed nitrogen (from which the Spanish physicians have named these waters *azoades*) consists in part of free argon and helium. The collected gas was in each case, after treatment with potash and phosphoric anhydride, introduced into a Plücker tube containing magnesium wire. Under the action of the silent discharge the nitrogen rapidly disappeared by combination with magnesium, leaving a residue exhibiting the characteristic rays of both argon and helium for the gas derived from the waters of la Raillère, helium from the springs of Bois, and helium together with probably an unknown gas from the waters of lowest temperature at Bois. The use of magnesium wire and the silent discharge is due to MM. L. Troost and L. Ouvrard, who show that the magnesium vapor produced very rapidly combines with nitrogen under the conditions obtaining in the tubes. Further, the continued action of a powerful silent discharge, for some hours after the spectroscopic evidence proves the absence of nitrogen, results in a gradual diminution in intensity of the helium and argon rays. Finally a complete vacuum is produced; hence it appears that magnesium combines with argon and helium under these circumstances. Platinum appears to behave like magnesium towards argon in Plücker tubes with the silent discharge.

ELECTRIC TRANSPORTATION DEPARTMENT.

THE E. M. CONDUIT RAILWAY SYSTEM.

The immediate success of the trolley railway with its overhead construction, and the alacrity with which city authorities granted permission for such work in the past, have served to crowd into the background other methods of supplying current to the moving car. But there has always remained a lurking desire in most communities to see the railway wires buried, and to this has latterly been added the wish of railway companies themselves, in large cities, for some system, which would permit of working their cars by an underground system, if such a system could be devised which would be thoroughly reliable and which at the same time would not be prohibitive as to cost. The railway companies have been led to this as well by the high cost for repairs and maintenance entailed by the present overhead trolley construction, as by the constant annoyance and delays in the traffic caused by defects and breakdowns, more particularly in bad weather and just at times when transportation facilities are in greatest demand.

Inventors have not been slow to realize the situation of affairs in this respect, and as a result we find them busy at work on the

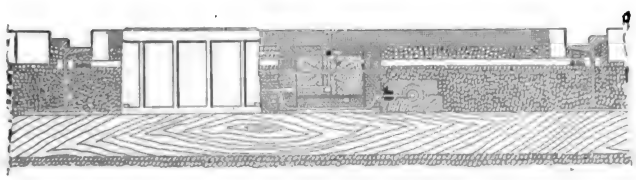


Fig. 1.—Section of Central Conductor, Rail, etc.

problem of designing an underground system fulfilling the objects above outlined. Among those who have been most persistent in their labors in this field is Mr. James F. McLaughlin, of Philadelphia, and the result of his labors is embodied in a section of closed conduit system which can now be seen in practical working operation in Philadelphia, and built by the Electric Magnetic Traction Co., who have undertaken the exploitation of the system.

The E. M. Railway System, as it is called, consists essentially of a conductor laid in sections flush with the pavement, midway between the rails, which sections are not part of the circuit, and hence are dead, under normal conditions; only when the car approaches a section does it become live, remaining so until the car has passed over the section, when the latter is again disconnected from the live feeders, and becomes dead; all these operations being performed automatically.

The operation of the system will be readily understood by reference to the accompanying engravings.

Fig. 1 shows the central conductor or rail in section, and Fig.

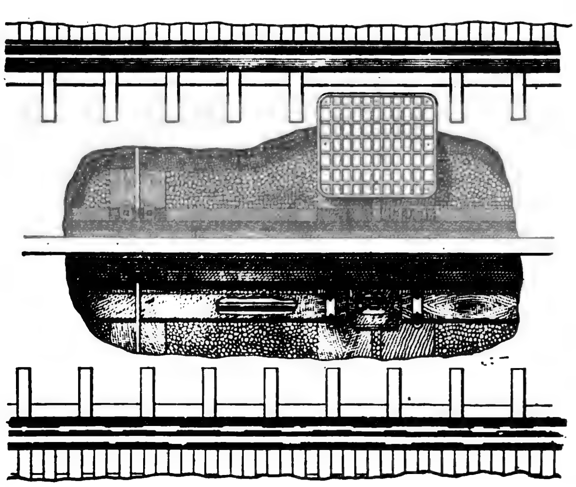


Fig. 2.—Plan of Track.

2 a plan view of the track construction. This central conductor is a three inch I beam, with a flat top $2\frac{5}{8}$ inches wide. The sections are eleven feet long, and are spiked to the top of a creosoted stringer, as shown in Fig. 1. The sections are separated by an interval of one foot. The longitudinal stringer is set in cast iron chairs, carried upon the cross ties, a chair being placed upon every third tie. Tie rods extend from each side of these chairs to the outer rails of the track.

The sections of the central rail are connected through junction boxes, one for each section, with what is known as the distributing conductor, which is laid alongside the longitudinal stringer underneath the pavement, above the ties, as shown in Fig. 1.

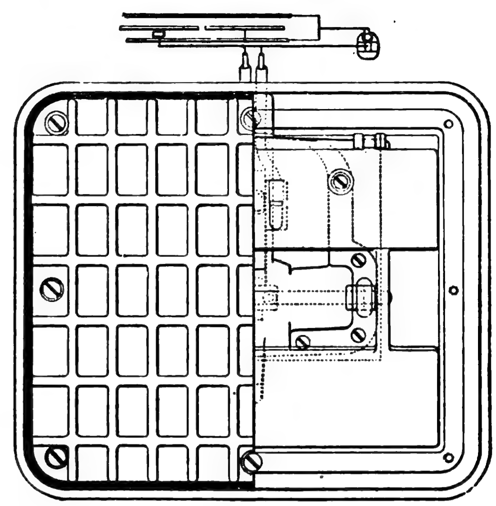


Fig. 3. Plan of Junction Box.

The sectional rail end of the connection is made by means of a connector screwed through a hole in the bottom of the longitudinal stringer into the under side of the rail. Through a lateral opening in the longitudinal stringer, a second connector is screwed into the first one, and to the outer end of this, by means of an ordinary coupling, is attached a lead-covered cable which leads directly into the junction box. The connection is made with the distributing main in a connecting box, as shown in Fig. 2, and from this a lead-covered cable leads underneath the longitudinal stringer and into the junction box. The opening through which these two cables pass into the junction box is shown in Fig. 3, this opening being hermetically sealed, so as to keep the inside of the junction box thoroughly dry.

Fig. 3 shows a plan view of the junction box, with one-half of the cover removed; Fig. 4 a longitudinal section, and Fig. 5 a transverse section of the same box. This box has a cast iron case, the cover of which is a composition of iron and brass. This can be hermetically sealed so that no moisture can get into the box. Practically all that this box contains is a jack knife switch with

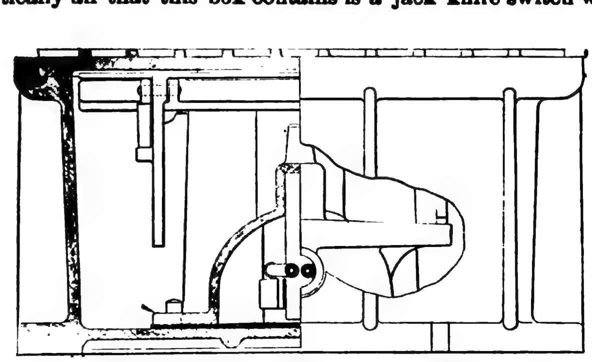


Fig. 4. Longitudinal Section of Junction Box.

means for opening and closing it to cut out and in the sections of the central contact rail. The mechanism for operating this switch, which is shown in Fig. 5, is exceedingly ingenious. The blade of the switch is hung vertically from a horizontal axis, the latter being near the top of the junction box, while the contact points of the switch are near the bottom, thus securing a long leverage for working the arm of the switch. This arm is placed underneath a case made of cast iron and approximately of bell shape, as shown in section in Fig. 5. The axis upon which the

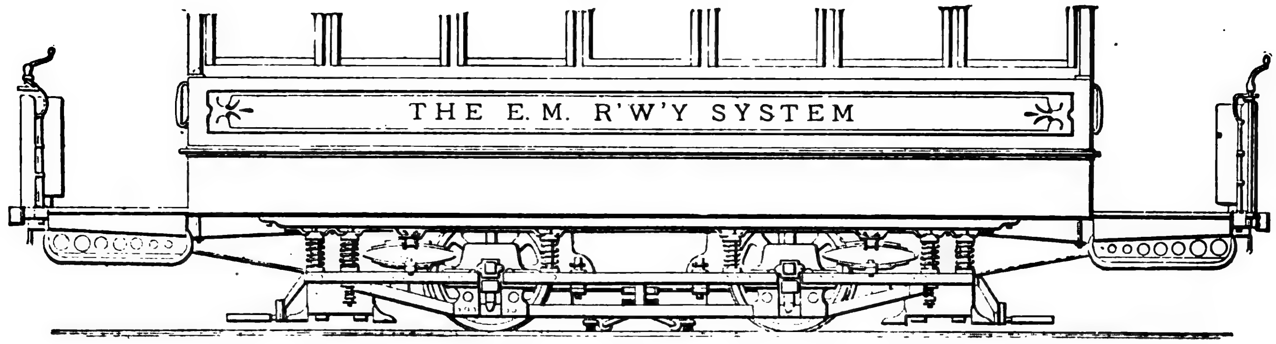


FIG. 6.—METHOD OF MAKING CONTACT.

switch blade is hung is the only part which projects through this bell shaped case. Across the ends of this axis extend two arms, which are connected at their ends by two cast iron plates. In fact, these plates, and the arms to which they are attached are made in one piece. It is evident that an up-and-down motion of these plates will close and open the switch alternately, thus cutting in and out the sections of the central rail. Just how this up-and-down motion is produced will appear when the electro-magnets carried upon the car are described.

A very ingenious feature of this junction box mechanism is the provision made for locking the switch in its "out" position, so that it is absolutely impossible for the circuit to become closed, and the central rail to be made "alive," except by the passage of an energized electro-magnet over the top of the junction box. In the position of the switch shown in Fig. 5, the circuit is closed and the switch, of course, in its unlocked position. When the swinging plate on the right is depressed, the switch will be opened and the latch, shown on the right just above the opening through which the cables pass, will drop into its position and be held firmly in place by the action of gravity on the upper and thinner locking plate. This plate, as will be seen in Fig. 5, is rigidly attached to the locking arm at the right and turns about a centre in the outer edge of the tilting arm. A second, or interior case, is placed upon a layer of asbestos, which thus intervenes between the blades of the switch and the outer cast iron shell of the box.

A side view of the car in Fig. 6 shows the location of the trolley contact and of the pair of large electro-magnets which operate the junction box switches. These magnets are carried at opposite ends of the track, a distance of thirteen feet apart

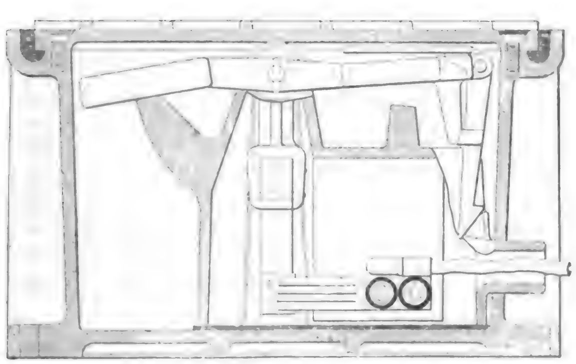


FIG. 5.—CROSS-SECTION OF JUNCTION BOX.

between centres. They are ordinary, inverted horse shoe electro-magnets, the pole faces of which are carried at a distance of three inches above the top of the junction box cover. The magnets are carried, of course, upon the truck frame in such a way as to be subject to a very slight oscillation. The armatures upon which these electro-magnets act are the tilting plates in the junction boxes. The magnets are both placed upon one side of the centre rail and so placed that one of them will pass directly over one end of the tilting arm, while the other coincides in position with the opposite end of the arm.

These magnet coils are connected across the circuit between the trolley—that is, the central rail—and the ground, which in this case, as in the ordinary trolley system, is the track rail and such supplementary circuits as may be used. The operation then is as follows, assuming that there is current in the distributing conductor, and in one section of the central rail, and that the trolley is in contact with this live section: The forward end of the car passes over the junction box of the next section and the energized electro-magnet, pulling upon the tilting armature, closes the circuit, making the next section of the central rail alive. The forward half of the trolley is in contact with this rail, and the car takes its current from this source, and the rear half of the trolley then leaves the preceding section as the car moves along. The electro-magnet at the rear of the car then passes over the tilting armature of the junction box corresponding to the section

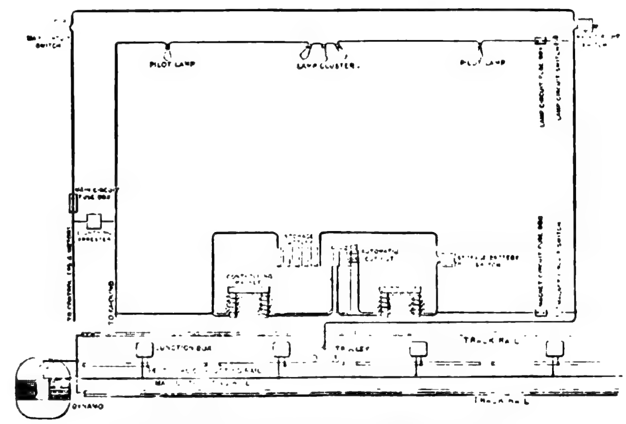


FIG. 7.—DIAGRAM OF CONNECTIONS.

of the rail which the car has just left, pulls open the switch and cuts out that section. This same operation is repeated for every section that the car passes over. It should be noticed that not more than two sections are alive at any one time; that the maximum length of live conductor is, therefore, twenty-three feet; that the current is cut into the section in advance before the trolley has left the preceding one, and that the rear section is inactive; that is, the trolley has left it before it is cut out of the circuit. This latter arrangement is intended to obviate the possibility of an arc at the junction box switch.

An arrangement has been devised, which is not shown in the illustration, for shifting the electro-magnets so that they may be made to pass over opposite sides of the junction boxes, and so that they may be made to follow the line of the junction boxes at crossovers, switches and similar places.

Fig. 7 shows a diagrammatic view of the connections, where these are shown so clearly that very little explanation is necessary. This shows that the track rails are connected to one side of the generator and the main distributing wire which connects through the junction boxes with the central rail leads to the opposite terminal of the dynamo. The controlling magnets are wound with fine wire, and are in series with each other and with an

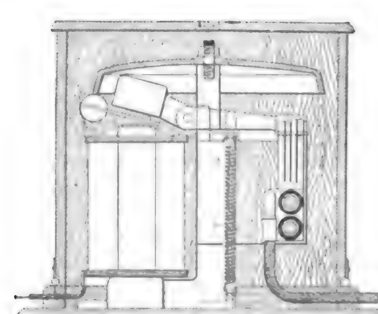


FIG. 8.—CUT-OUT.

automatic cut-out which opens the circuit if for any reason the current is interrupted through the coils of the controlling magnets. At the same time it throws into circuit a bank of five storage batteries which are connected through a second and coarse

winding on the controlling magnets. Fig. 8 shows a detail of this cut-out, the object of which is simply to provide a means of controlling in an emergency the junction box switches, when from any reason, such as the blowing of a fuse, the electro-magnet might become de-energized.

The track construction contemplated for this system is shown in Fig. 1, where the entire space between the rails is filled with cement, except the street surface, which is asphalt. Vitrified brick is used along the rails. The company contemplates the use of a 500 volt current, and does not anticipate any difficulties arising from leakage or the possibility of short circuits between the live sections of the central rail and the track rails.

The offices of the Electro Magnetic Traction Co. are at 608 Chestnut St., and the works at 24th St. and Sedgely Ave., Philadelphia, where a section of track equipped in the manner above described is in working operation.

TIES AND POLES.[1]

BY N. W. L. BROWN, C. E.

(*Assistant Supt. Atlanta Consolidated Street Railway Co.*)

A thorough examination has shown conclusively that six years is the longest life we may expect of select pine.

In tearing out horse car and dummy tracks we have frequently found oak ties of which accurate records could be had, and from these we are led to believe that eight years is the longest life we may expect of oak.

We have conferred with many street railway engineers and find positively no uniformity of opinion or practice as to the best tie to use. One engineer prefers and uses oak, another tamarack, another chestnut, another cedar, another cypress, another Georgia pine, and a very few engineers claim to have solved the problem of ultimately the most economical track construction by adopting metal ties.

It seems to be generally conceded that metal ties require for their proper foundation a thorough bedding in concrete, and if it is granted (as claimed by a few American and many English and Continental engineers) that a concrete foundation is necessary in any good track, then the selection of metal ties may bespeak good judgment in deep rail construction, but most American engineers claim that concrete is not necessary in first class track construction, and if this opinion (in which we heartily concur) is correct, then there can be few cases, if any, where metal ties would be most satisfactory and economical.

In New Orleans excellent results have been obtained under horse car tracks with red cypress, which is reported to have been in good condition after twenty-eight years of service. Red cypress and especially black cypress are among our most durable woods, but their extreme softness and inability to properly hold spikes have been a serious hindrance to their extensive adoption for railroad ties. The extraordinary results reported in New Orleans are doubtless due to the light requirements of horse car service, and the fact that these ties were always in very damp, marshy earth, if not actually submerged in water.

A prominent timber expert of our city estimates that black cypress in our tracks ought to last about ten years and the information before us leads us to believe that this estimate must be about correct.

After consulting all the few reports and treatises available upon the subject of timber preservation, we have conferred again with many members of the Am. Soc. C. E. and other experts, and our opinion seems to be universally endorsed that efficiently creosoted ties are ultimately the most economical for use in street railway work.

At present we omit the vulcanizing process, which has in a few cases given good results, but whose merits are still in a measure in question. We can say that the preservation of timber in quantity is confined almost exclusively to two standard, and long established processes, viz., burnettizing and creosoting. Burnettizing, or the treatment with zinc chloride, is the process (modified by patents in some cases) most extensively used in America for the preservation of railroad ties, mainly on account of its least cost, its resistance to being burnt, and on account also of its being simpler or safer than the treatments by the injections of other metallic salts.

Burnettizing is extensively used in the West, and it has given good results, especially in dry localities, but there are many conditions met with in street railway construction which are unfavorable to its success.

1st. Zinc chloride is a salt easily washed out when exposed in wet localities.

2nd. Leakage currents from the rails might hasten its disappearance.

3rd. It has a tendency to rust the rails and spikes.

The creosoting process was invented and established in 1838 by Jno. Bethell, of England, and for many years past it has been almost universally used in England and France for the preservation of ties and telegraph poles. Creosote timber is in many respects peculiarly suited for street railway ties. Creosote cannot be washed out, and being a perfect insulator, is beyond the reach of the electrolytic action of leakage currents. It might have an important bearing (especially in stringer tracks) on reducing the leakage from the rails to the water mains, etc. Its tendency is to prevent iron and steel from rusting.

For a time 6″ x 8″ x 7′ were our standard dimensions for ties, but over a year ago we changed these to 5″ x 9″ x 7′ and consider our present standard more satisfactory.

We have recently used three thousand sap pine ties from the Fernandina Oil and Creosote Works, and are expecting good results from them. These ties, treated with 12 lbs. of dead oil of coal tar (creosote) per cubic foot, can be delivered F. O. B. cars Atlanta, for 60 cents each. First-class pine ties now cost as 26¼ cents each, oak in quantity 30 cents each and black cypress about 40 cents each.

We know that our present scale of wages, the labor of tearing up and renewing track paved with ordinary Belgian blocks with a sand foundation and filling will cost about 36 cents per lineal foot of single track, and hence we can readily make a comparison for determining the most economical tie to use. From the information before us, we feel sure that we can safely assume twenty-four years as the life of a creosoted tie, and with this assumption we will determine the cost of keeping the different kinds of ties under sections of track for twenty-four years.

Assuming the ties to be spaced 2′ 6″ apart centre to centre. Creosoted ties will cost 24 cents per lineal feet of track, therefore 60 cents (36 + 24) will represent the cost of labor and ties per lineal foot in rebuilding. Principal and interest on 60 cents at 6 per cent. for 24 years, $1.46, which is the actual cost per lineal foot of keeping ties under this track for 24 years.

Cypress ties will cost 16 cents, (36 + 16) will represent the cost of labor and ties per lineal foot in rebuilding where they are used. With a life of twelve years, which is generally assumed as the maximum in railroad practice, two renewals would be required in 24 years, therefore for the first renewal:

Principal and interest, 52 cents at 6% for 24 years...	$1.27
and for the second renewal,	
Principal and interest, 52 cents at 6% for 12 years...	.89
Total....................................	$2.16

Oak ties will cost 12 cents per lineal foot and 48 cents (36 + 12) will represent the cost of labor and ties in rebuilding, where they are used. With a life of eight years three renewals would be required in 24 years, therefore for the first renewal:

Principal and interest, 48 cents at 6% for 24 years...	$1.17
For the second renewal,	
Principal and interest, 48 cents at 6% for 16 years...	.94
For the third renewal,	
Principal and interest, 48 cents at 6% for 8 years...	.71
Total....................................	$2.82

Pine ties will cost 10½ cents per lineal foot and 46½ cents (36 + 10½) will represent the cost of labor and ties in rebuilding, where these are used. With a life of six years four renewals would be required in 24 years, therefore for the first renewal:

Principal and interest 40½c. at 6% for 24 years....	$0.988
For the second renewal,	
Principal and interest 40½c. at 6% for 18 years....	0.842
For the third renewal,	
Principal and interest 40½c. at 6% for 12 years....	0.696
For the fourth renewal,	
Principal and interest 40½c. at 6% for 6 years....	0.551
	$3.077

From these comparisons we see that with the lives assumed, cypress will cost 48 per cent. more than creosoted timber. Oak will cost 92 per cent. more than creosoted timber. Pine will cost 111 per cent. more than creosoted timber.

These comparisons assume that the service of the different ties during their lives is equally satisfactory, which is practically correct in the case of oak, pine and creosoted pine, but cypress, on account of its softness, gives inferior service. These figures take no account of the disturbance to travel and to residents along the street while renewals are going on, nor do they consider that repairs are necessary long before complete renewal, and that these repairs would be much less where the track was going to pieces once than where it was going to pieces several times in a given time.

We have assumed in this comparison contract prices on creosoted ties delivered here by rail from a point many hundred miles distant, and we believe that street railway companies can creosote their own timber at much less cost generally than they can expect to have it done by contract.

1. Abstract of paper read at the Montreal Convention of the A. S. R. A., October 15-18, 1895.

These creosoting establishments are generally extensive affairs, and while they may be kept busy for months at a time we think it is a fact that their interest on investment, salaries for expert superintendence, sales department, labor, etc., are much more regular items at least than their orders.

We feel that it would be economy for any street railway company operating extensive mileage, and affected like ourselves with short lived ties, to install a small creosoting plant on the power house premises, which are generally large, and supply this plant with steam from the main boiler plant and with power for its pumps, etc., by means of electric motors. In this way expert superintendence could be given by the chief engineer, the plant could be operated most economically, and when lying idle the interest on the cost would be about the only expense connected with it.

We estimate that a plant, consisting of a treating cylinder, 6′ in diameter and 36′ long, with a capacity of about 300 ties a day, should not cost more than $6,000 complete with necessary cars, pumps, tanks, superheating apparatus, etc., necessary for operating it. Not only would such a plant be of service for ties, but also for treating floor timbers for cars, trestle and bridge timbers perhaps, and especially for treating cross arms and—

POLES FOR LINE CONSTRUCTION.

Red cedar poles have been almost universally used in our overhead construction, although iron poles set in concrete have been used in the heart of the city, and cypress poles have been used in a few cases when we could not secure cedar promptly.

The specifications by which most of our cedar poles were purchased required 28′ in length and a minimum top diameter of 6″, but these poles proved too small and in many cases, too short, especially where guard wires are required.

These red cedar poles for this market are generally obtained in East Tennessee, although the timber exists more or less bountifully in many sections of the South. It has been used almost exclusively by the Western Union Telegraph Co. and they estimate that their poles last on an average about fifteen years. The sap generally decays in five or six years, and in many cases they find that the heart decays in twelve years, while again in many cases it will last twenty years.

Cedar poles, especially when used according to the ordinary custom, have many defects in street railway service.

1st. Their life is practically limited to the life of their sap, as when this decays the heart left is too small and weak for reliable service.

2d. Larger poles are liable to be very defective, generally being hollow at the butt, and frequently containing rotten knots.

3d. Cedar is very brittle and treacherous under tension.

4th. Large, short poles are excessively expensive, as they are equivalent on the market to long poles cut off.

We are now estimating that our cedar poles with large hearts will last twelve years. The cedar poles we have used appear to have cost us about $4.00 each, erected.

Our iron poles which have cost about $18.00 each erected, do not appear to be lasting as well as was hoped. They have too great a tendency to rust near the ground, and we doubt whether they can be safely depended upon for more than fifteen years.

We believe properly creosoted pine poles, 30′ long 8″ at the top ordinarily, and 10″ to 12″ at the top where special demands are made upon them should be equal in point to excellent service, and superior in point of long service to any poles on the market.

These poles, treated by contract to 10 lbs. of creosote per cubic foot, should not cost more than $5 each erected, and when treated in one's own plant, this price could doubtless be reduced to $3.50.

Pine in its growth is one of the most perfect and symmetrical of all timbers, besides having a tensile strength about twice as great as cedar. Creosoting is generally conceded to increase the strength, and all these properties would seem to indicate that the creosoted pine pole should be strong enough and neat enough for city work, but it is the long life that makes this pole most eminently suited for street railway work.

Mr. W. H. Preece, the celebrated English telegraph engineer, reported in 1884, as a result of thirty years of experience, that he had never seen one single properly treated telegraph pole which showed the least decay, and he referred to 318 poles, which after 35 years of service were torn down to make way for larger poles, every one of which showed after this service no signs of decay. Creosoted poles are universally used in English telegraph work. The District Supt. of the Western Union Telegraph Co. here tells us that he was recently asked to examine a lot of creosoted poles, supplied to his company for experiment by the works at West Pascagoula, Mississippi, twelve or fifteen years ago perhaps (as well as he remembers), and that he found everyone in perfect condition. He dug down to the bottom of many and could find no sign of decay. Creosoted poles installed near St. Augustine, Fla., in 1888 have within the past few days been examined fully and are reported by the superintendent there, of the Western Union Telegraph Co., to show as yet no trace of decay. Creosoted poles have a great advantage in being perfect insulators, over iron poles, which are grounded conductors, and liable to cause accidents to the lines and linemen. If creosoted poles are superior to cedar in almost every respect, the question naturally arises, why are they not adopted by the Western Union Telegraph Co.? This question is easily answered. Most of the poles of this company are along the railroads and insecurely protected against fire. A creosoted pole is very inflammable and they are afraid this one great disadvantage in their work would more than offset its advantages.

Much has recently been done toward developing to perfection the rational standards in street railway engineering practice, but we feel that these standards in track and line construction would be, as a rule, improved by the use of creosoted timber.

THE WHITTINGHAM ELECTRIC CAR HEATER.

Among the exhibits at the Montreal Convention which attracted general attention among the delegates present, and which was welcomed particularly on account of the arctic temperature which prevailed in the Exhibition Rink, were the Whittingham electric car heaters. These heaters, which are built by the Whittingham Electric Car Heating Co., of Baltimore, are composed of wrought-iron pipes running the full length of the car, on either side, fitted in suitable castings, and attached to the riser of the seat. Each pipe contains a coil of Krupp wire,

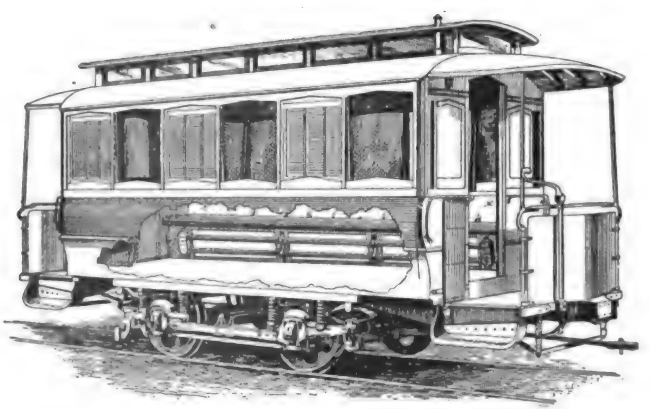


Fig. 1.—The Whittingham Electric Car Heater.

enclosed within a heat-conducting, insulating tube. The tube and wire are then placed inside the wrought-iron pipe, and both pipe and tube are thoroughly packed by machinery with chemically pure silica. This construction surrounds the wire with the best possible heat conducting medium, at the same time perfectly insulating it from the wrought-iron radiating jacket.

The particular advantages claimed for this form of construction are first, that the life of the heater is practically that of the pipe, as it is impossible for the wire to reach a temperature which can have any injurious effect upon it. The heater exposes a radiating surface of from 3,500 to 4,500 square inches, from which it follows that the desired amount of heat can be developed with the apparatus at a proportionately lower temperature.

The distribution of heat is such that the car has no hot

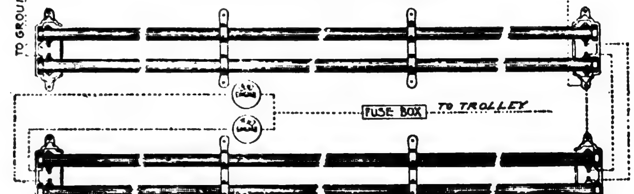


Fig. 2.—The Whittingham Electric Car Heater.

corners and no cold corners, but an even heat arises from the moderately heated pipes, and makes each part of the car equally comfortable and agreeable.

The capacity of the heater is greatly in excess of its commercial rating. For example: A single pipe in regular use absorbs about 3 amperes at 250 volts, or 750 watts. A load of 4000 watts can be placed on the tube without any injurious effect; in fact, heaters have been in use for over a year, which have been operating continuously at a load of 110 watts per linear foot. The temperature of the heater at all points is perfectly safe, viz., 180 degrees; safe for the woodwork, the passengers and the material of which the heater is constructed.

The illustration Fig. 1 shows the method of attaching the

heating pipes to the riser of the car seat. Malleable iron castings are bolted to the riser of the seat, and the heating pipes are securely supported in position by means of grooves in the castings, into which the octagon caps in the ends of the pipes are fitted. Retaining clamps are then bolted over the pipes at proper intervals. The customary flap of carpeting, which usually hangs down some six or eight inches from the edge of the seat is omitted in order to show up the distribution of the pipes; but with the carpet in place, it requires a careful observer to detect the heating equipment.

The diagram, Fig. 2, shows the connections between the switches and sections of the heater; also the manner of grounding the iron frame work. It will be seen that two of the heater pipes, one on each side of the car, are connected in series, and controlled by a simple quick break switch. The two remaining pipes are similarly connected, and both series fed through a common fuse. This method gives an equal distribution of either half, or full heat, to all parts of the car, and furnishes practically two independent heaters, controllable at will, by its individual switch.

THE PRESENT STATUS OF THE AIR-BRAKE.[1]

BY E. J. WESSELS.

LAST October the speaker had the honor to lay before the members of the American Street Railway Association in Atlanta a paper on the subject of Power Brakes vs. Hand Brakes. In that paper reference was made to the advantage of a good air-brake and the desirability of its adoption on roads with congested traffic, high speed or severe grades, and especially where trailers are used. At that time the street railway air-brake was in swaddling clothes. Some, not positively indifferent on the subject, proved hostile. When asked their objection to its adoption they generally answered, "The air-brake costs too much." Some of the members asserted that hand-brakes answered their purpose and they saw no need for substituting air-brakes. The speaker claimed that every car should have both air- and hand-brakes. To contend against this opposition has not been easy. It takes a long time to convince some men that first cost may not mean much and often in reality proves but a forerunner of excessive outlay. Per contra, sometimes things said at the start to "cost too much" are *cheapest* in the last analysis. Prices must be judged by relative values and mean nothing unless one *sees* the apparatus.

In considering the present status of the air-brake it is pleasing to notice that the indifference which existed even in influential quarters has largely disappeared. Months ago a prominent railway president asserted that he would not put an air-brake on his road because, if he did, there would be nothing for his motormen to do. Since then he changed his mind and recently contracted to have every car on his road equipped with air-brakes.

It was asserted in the speaker's Atlanta paper, and may be proper to repeat here, that the object of the present paper is not to advertise any special make of air-brake, but to call attention to air-brakes in general, applicable to passenger and freight electric and cable cars. Most managers now concede that the old form of hand-brake will no longer answer for heavy, double-truck, high speed cars. There has been a remarkable change of views since we last met. It is now admitted that more reliable braking apparatus must be secured. In fact, in several quarters even the question of expense cannot be said to be the chief one. Some go so far as to say "We must have better brakes at any price." There are instances on record where certain roads have contracted for more reliable braking apparatus at a cost which a year ago they regarded prohibitory. In their extremity these roads naturally turned to those manufacturers who have made air-brakes a study.

It is manifestly unadvisable for a street railway company to turn out its own brakes. The question is such a difficult one, the outlay for experiments is necessarily so immense, that no individual road is justified in undertaking the business. Some roads build their own rolling stock, but it is easier to build cars than air-brakes. An air-brake which has merely been tested in the *shops* is of doubtful utility. It cannot be depended upon for the rough usage it will encounter in service. No air-brake is fit to be mounted on a car, which has not gone through the most crucial tests based on records of similar brakes operated on cars for many months.

To design an air-brake which shall be mechanical, durable and economical is one of the most diffcult problems a manufacturer can face. It is comparatively easy to design apparatus which will work admirably if left undisturbed in the shops; but that same apparatus, when transferred under a car, in a short time may be battered beyond recognition.

The street car air-brake has much to contend with:

1. The unfamiliarity of the average motorman with the proper use of air, is greatly against it.

2. The compresser is begrudged space on the car axle, although generous space is freely given to electric motors irrespective of dimensions. This makes it difficult to have proper bearing surfaces.

3. The neglect of proper inspection is greatly against the air-brake. Even motors do not receive the attention they should, as many a scrap heap testifies. The air-brake hardly receives any.

4. Insufficient lubrication. The same man who lubricates his motors, passes by the air-brake without using his oil can. Probably he might neglect to oil the motors, but he knows that failure to do so would be speedily detected and render him liable to discipline. The air-brake has not reached that point in street railway operation, where neglect to lubricate it produces like results. The most perfect apparatus ever designed, if neglected, cannot do its work properly, and no automatic oiling machinery or mechanism under a car can possibly replace human vigilance.

A year ago the air-brake was not found on many roads. On the few roads where it was being used, satisfactory results were obtained, and in the *Street Railway Journal* for March last, in the article entitled "The Street Railway System of Buffalo, N. Y.," a report of the successful operation of air-brakes there will be found. It showed that by using air-brakes there had been a great saving in wheels. As a matter of fact, there should not be any flat wheels if air-brakes are properly used, for by their aid pressure can be regulated to a nicety.

Any good brake is better than a poor one, and we welcome into the family our friends who since the last Convention have put on the market several excellent types of mechanical brakes.

As, however, in street railway practice we are closely following (if not really leaving behind) steam practice, it is reasonable to conclude that if mechanical brakes were the solution of the braking problem, they would be found on steam roads instead of the well-known Westinghouse air-brake. An examination of the patent office records discloses the fact that scores of patents have been granted for mechanical brakes for steam cars, but one would have to travel far to find a solitary mechanical brake in service on steam roads. If they have proved unfitted for steam practice, and the air brake has been adopted, it is fair to assume that mechanical brakes may not be all that is required for braking electric and cable cars. It is always better to replace human muscle by some controllable, potent force; and compressed air, under proper conditions, seems to be that ideal force.

The speaker recently returned from an extended trip through Europe. He rode on hundreds of cars in different places, from the North of England to Budapest, but did not find a brake on any steam road operated by anything but air, vacuum or steam. Investigation proved that air-brakes were much preferred to all other forms. Some trains used the automatic, some the non-automatic. He also found that inspection on most lines was ideal. Not only were the brakes tested, as we test them here, but on many of the trucks diagrams were painted with the words "to be lubricated every so-many days." It was the duty of the car tender to chalk in the squares painted underneath, the days when apparatus received attention.

The street car air-brake has been adopted by the Australian Government; it has been specified by borough engineers in Great Britain; it is being installed in different places on the Continent. It is, therefore, somewhat discouraging to find that while the street car air-brake receives very careful attention abroad, it is denied that attention here. It is unfortunate that our managers entrust it to uninstructed men who have had no experience in its use. No one anywhere would be permitted to handle the Westinghouse triple valve who had not served his apprenticeship of from three years upward, and firemen are not allowed to touch it. The locomotive runner alone is entrusted with it and held strictly accountable for its misuse. More than one runner has been discharged for bad use of his pressure. The street railway air-brake is entrusted to green men who sometimes don't know enough to use their electrical apparatus properly.

The air-brake for steam roads has undergone an evolution beginning in 1869. Even its most ardent supporters will not claim that the system as applied to-day is absolutely perfect; but it is *commercial*, and unquestionably has saved hundreds of lives in the past twenty-seven years. If it has taken that long to bring the present steam car air-brake to a measurable degree of perfection, what may we not hope to see accomplished by the street railway air-brake in a very much shorter time? There is a book which has reached a third edition entitled "Diseases of the Air-brake System. Causes, Symptoms and Cure," devoted exclusively to steam road air-brakes. This, too, after twenty-seven years' experience. Should we expect perfection in the more youthful street railway air-brake which has only been in existence for some three years?

The duties required of a street railway air-brake are more severe than those demanded of a steam car air-brake. The steam train makes very few stops. The stations are well known and the roads are provided with proper gate crossings and the block system. In numerous places grade crossings have been or are being abolished. Even the engineers of the Empire State Express do not face the risks to which the motorman of a fast, suburban electric train is constantly exposed. The electric train very often stops where there are no stations, where passengers stand between

1. A paper read before the American Street Railway Association, Montreal, Oct. 15-18, 1896.

the rails frantically waving so they will not be left. There being no definite time when the train passes crossroads, the motorman of the electric train is menaced by farm wagons and other vehicles, deaf people, bicycle riders and others, who would not attempt to cross the track if the Empire State or other express was due. It is placing a motorman at fearful disadvantage to entrust him with a twenty-five-mile-an-hour (and more) train, as is now being done, and failing to provide him with the necessary means for emergency stops!

The air-brake is the only brake which has an emergency stop that can be instantly applied by the easy turning of a handle. Other brakes require muscular effort and generally a number of turns before the breaking power becomes effectual. In order to have even an approach to an emergency stop, it is generally necessary with hand-brakes to gear them to a point which they would never reach, were the semblance of such stop not required. This excessive gearing means rapid wearing out of parts and needless tiring of muscles.

It is not claimed that the street railway air-brake has reached perfection. It is believed it never will reach that point unless through the co-operation of the railway managers. But even though it is not claimed that the present street railway air-brake is all it should be, we must admit it has made remarkable strides, that satisfactory results have been produced, and that it is commercial. It will not be possible to overcome all the objections to an air-brake unless managers rally around the men who are striving to reach perfection. It is only by braking cars in actual service that important knowledge of the air-brake can be gained. There were air-brakes which entered the lists at the last Convention, which have retired from the field, but some are still bearing the heat and burden of the day. It is a case of the survival of the fittest; but even if an absolutely perfect air-brake was in existence, it would stand in jeopardy every hour, so long as an uninstructed motorman is permitted to handle the controller.

Those of us in the midst of the conflict do not despair of being able to turn out an ideal air-brake which will operate satisfactorily under all conditions. If that brake could be delivered to-day, and would pass muster before a jury of microscopists, there would still be the factor of neglect and inattention of motormen to contend with.

We may not in this stage of the art expect that leading roads will maintain schools of instruction, nor can the manufacturers of air-brakes, from the low selling price, support such institutions; but surely it is reasonable for them to expect that motormen should undergo preliminary instructions, and that the simple operating directions shall be faithfully adhered to. When a man applies for admission to the police force he must undergo a severe examination. One of the questions recently asked was, "If there were 4,796 persons in a district and there is one Swede to every three Germans and five Irish, how many Swedes, Germans and Irish are there in that district?" If this sort of an examination is required of policemen, should not suitable tests be applied to motormen?

The speaker recently read a letter from which the following is quoted as giving evidence of what the air-brake has to contend with in some places: "This is by all odds the dirtiest city in the world. Our men are of the lowest degree of human intelligence, utterly incapable of understanding or taking care of any kind of machinery. We are unable at times to keep our cars on the road for lack of motormen. Another difficulty is the possibility of braking the car with current on. Our men are also incapable of appreciating that a little is frequently enough, and almost invariably bring the car to a full stop when they only wish to slow down."

Fortunately in the United States such a deplorable lack of intelligence does not exist. Our motormen are far more intelligent, and the recent prolonged financial depression has enabled managers to secure better men than were formerly obtainable. It is gratifying to find that many motormen are anxious to improve their condition and to become more useful to their employers. Many of them send in requests for literature so they may have a more intelligent idea of the apparatus entrusted to them. While this is true of many, we cannot overlook the fact that there are others not so desirable, men who have little ambition and who expect to remain motormen as long as they are able to turn a handle. These claim they render a fair equivalent in work for the wages paid. They forget that the way to secure higher wages is first to show greater proficiency. They remind one of the brakeman who was complained of by passengers for not announcing stations distinctly. His defense was that he could not be expected to sing tenor for $30 a month.

The cry about trolley slaughters has subsided. Six months ago it had reached large proportions, but the riding public is beginning to realize that even if managers are anxious to minimize accidents they cannot reach the safety point unless a superior class of apparatus is within their reach.

Since we last met, fenders have been made compulsory in several cities. Those who believe most in fenders will not deny that a reliable brake is an absolute necessity. It may be advisable to have both. That is for you to determine. It is probable that air-brakes would have been made compulsory on street railways long ago, had the manufacturers of commercial air-brakes devoted their energies to influencing legislation, instead of concentrating them wholly upon the perfecting of the air-brake. It is, however, extremely probable that before long the air-brake also will be made compulsory, and this is a good argument in favor of testing it in actual service *now*, so that if it becomes compulsory, managers will be familiar with its advantages.

The claims of the air-brake over other forms of brakes were fully defined in the Atlanta paper referred to and need not be repeated. At that time the electric brake was actively opposed to the air-brake. The opposition has since faded away. There has not been, nor is there, an electric trailer brake. If we are to have a reliable electric, motor-car brake, the brake must apply equally well to trailers. Until the advent of an electric trailer brake, the air-brake must certainly be regarded its superior for *train* service, especially as the air-brake dispenses entirely with brakemen and gives the motorman absolute control of his train.

Not much is being said about cables although cable roads in large cities are handling, and probably will handle, vast traffic. The use of the combined air grip and brake device on the market means a decided prolongation of the lives of cables with far better brake control than is possible with the levers usually employed.

The street railway air-brake is in a transition state and is going through some of the processes that characterized electric motors. We would not have the superb motors in service to-day, had not manufacturers been able to learn the defects of the pioneer motors through the reports and suggestions of their railway friends.

Fenders, car heaters, lighting systems and other things are now going through these same processes. Hence it is not singular that the air-brake shares the common lot.

The questions to be considered are: 1. Are better brakes than hand-brakes necessary? 2. Will not the demand for better brakes grow even more imperative day by day? 3. Will not some form of *power*-brake become compulsory ere long? 4. How can the valve of any brake (mechanical or otherwise) be judged except by tests in everyday service? 5. How can anything (brake or otherwise) undergo a fair test unless the men who use it are compelled to observe ordinary diligence? 6. How can any movable machinery or apparatus be expected to work satisfactorily, unless the moving parts are kept properly lubricated? 7. Can you afford to operate without having a reliable braking system for checking speed or making service and emergency stops?

If you desire to test an air-brake it will not be difficult for you to secure one, and, if perchance, it fails to do *all* you expect of it, it will be an unwise manufacturer who will not avail himself of any suggestions you may make in the light of your own experience. Let us not forget that your interests and the air-brake manufacturer's are and always will be identical.

Discussion of this paper will be found on page 400.

IRON CLAD TROLLEY CARS NEEDED IN CHICAGO.

Five armed and masked men held up a trolley car of the North Shore Electric Street Railway Company near Berwin Ave., between Chicago and the suburb of Evanston, one night recently, cut the wire, thus preventing assistance from following cars and putting out the lights, and then robbed the eighteen passengers of their money and valuables. A passenger named T. P. Nesbitt of Evanston drew his revolver, but it was knocked from his hand by one of the robbers and discharged, the bullet striking Nesbitt in the leg. The conductor saved his money by dropping it down between the walls of the car and the window openings. The robbers escaped.

THE DRAWING POWER OF THE B. & O. LOCOMOTIVE.

On Oct. 6, electric Locomotive No. 1, used in hauling freight trains through the Belt Line tunnel of the Baltimore and Ohio Railroad, demonstrated that its drawing power far exceeded the expectations of its builders. Forty-four loaded freight cars, and three steam locomotives, not working, which had been used to haul the heavy train on the surface, were coupled to the electric giant at the tunnel entrance and pulled up the heavy grade of the tunnel, a speed of twelve miles an hour being developed.

The total weight of the train was 1,900 tons. The drawbar pull exercised in starting this unusually heavy load was more than 60,000 pounds and continued throughout the trip at more than 40,000 pounds. Baltimore and Ohio officials claim that no steam locomotive ever approached this record. No. 1 has been in regular service day and night since August, hauling freight trains through the tunnel and has not missed a trip. Two smaller locomotives are building at the General Electric Work at Schenectady, N. Y., and upon their arrival in a few weeks the passenger service will be taken up and the tunnel operated entirely by electricity.

REPORT OF THE COMMITTEE OF THE AMERICAN STREET RAILWAY ASSOCIATION ON PATENTS.[1]

AMONG the many perplexing problems that have demanded the attention of some of our Western street railways is the question of "worthless patents," and it being evident to several gentlemen of the street railway fraternity that an association to handle all matters pertaining to patents, as affecting street railways, would be highly beneficial to all concerned, a Committee was appointed at Atlanta to take up the matter and submit a plan of organization.

This Committee, working upon the lines suggested, has investigated the matter, as far as it has been within their power, looking up facts and matters pertaining thereto, and desire to submit to you the following report for your careful consideration.

The majority of street railways have, at one time or another in their history, been sued for using or making some device, which was an alleged infringement on some patent. These cases were either fought out in the courts, or settled by the railway company, rather than go to the expense of court costs and attorney's fees. A large proportion of railways have paid and are now paying royalties, either directly to the patentee, or indirectly to the manufacturer (the royalty in the latter case being included in the price of the article paid by the purchaser) on certain articles in use on their systems. These direct royalties are often paid when exacted, to avoid going to the expense of hiring an attorney to look up the patent papers to see if the claimant has a good patent and a valid claim to his royalty. The writer knows this to be the case with the company with which he is connected. The expense of investigating such matters is often more than the amount involved, hence the matter is settled upon the payment of a few hundred dollars. The manufacturer should stand the burden of infringement suits, and not the purchaser, and the advantage of an association of this kind would be to influence or compel the claimant to direct his suits against the manufacturer and not the railways. Since the adoption of electricity as a motive power, we find that the number of patented articles in use on street railways has increased wonderfully. We are confident that a large number of these patents are worthless and will not "hold water."

Were these alleged patents to be investigated, a great number would become common property, on account of the patent feature becoming eliminated and hence the patentee would be deprived of his royalty, and the manufacturer would at once reduce his price in consequence. We do not mean to say that the honest inventor is not entitled to his royalty, provided he has a good bona-fide invention. It is clearly evident that if the street railway companies were combined together in an association of this character, that the expense to each would be small, while the advantages will be manifold. Another important item will be the assistance of the association in advising its members concerning new inventions of their own employees, whether said articles are patentable, or whether infringements on other inventions: said assistance to be furnished free to said railway companies which are members of the association. This will serve to encourage employees to work out improvements in devices in use on street railways and protect them in their rights. The advantage to the company presenting such new invention will be that they will be permitted to use said device free of royalty.

A great many devices in use on our system are common property at the present time from the fact that the patent has expired, yet how many members of this Association know the expiration of the patent limit on a single device in use on their road, and in ignorance of such facts are still paying the same old price.

The idea of such an organization of this kind was prompted by the fact that two similar ones have been in existence for over twenty-four years for the benefit of the steam railroads, and have been highly successful in every detail. One of these Associations is located in the East and the other is located at Chicago, and the two include as members all the important railroads in the country and a large number of the smaller roads.

The object of the Western Railroad Association, as stated in its by-laws (from which I quote) is as follows: "The object of this Association is the investigation of all patents and improvements affecting the interests of railroad companies, members hereof, and their mutual protection against the unjust and unreasonable claims and demands of patentees and their representatives, and the procuring of other information which may appear to be of value to the Association."

We have had several conferences with the general counsel of this Association, and he has been very kind in giving us information regarding the working of his Association. He also declared that an Association of like nature for street railways will be highly beneficial to all concerned, and recommended it. I have with me a copy of their Constitution and By-Laws, also a copy of their annual report for the year 1894, which is worthy of inspection and a valuable guide to the street railway interests.

This Association is maintained by an annual assessment of its members based on the gross earnings of the several railroads, payable in quarterly installments. The expenses of the Association consist of the salary of an attorney, office help, rent, travelling expenses, court expenses, patent office books, pamphlets, etc., and is conducted on a more expensive scale than would be necessary in a like organization for street railways. For instance in the beginning our Association might not feel like hiring an attorney to give his entire time, but only pay him for actual work, on fixed rates. The expenses for the first year would, of course, be larger in proportion than the following.

The Western Railroad Association have won four-fifths about, of their suits, and stands all expenses connected with said suits, but does not, of course, pay any judgments: the defendant road paying any judgment that may be entered against them. The entire membership, however, obtains the benefit of all such trials. The work performed by the Western Railroad Association in 1894, if done through the regular channels by the roads themselves, would have cost about ten times as much as was paid to the Association during the year for same. It is the practice of the roads belonging to the Association not to put on any new device without first referring same to the Association for advice. The number of suits against the railroads have been reduced very materially since this Association was started, and $60,000,000 in judgments were defeated in one year. One of the large trunk lines paid $10,000 for using a patented article that was afterwards found to be worthless so far as the patent feature was concerned. Since then they refer all such matters to the Western Railroad Association before adopting devices or settling claims of this character.

A certain street railway, so we are informed, paid $1,500 to prevent suit on an alleged infringement, and the patent was worthless, as was afterwards learned; this might have been saved if an organization of this kind was in existence.

One of the roads represented at this Convention is negotiating at the present time with two different firms on matters that could properly be referred to an Association of this character. One of the articles in question is used by all electric railways in large quantities, and the inventor is receiving large royalties from the manufacturer. A patent attorney informed the road that he thought the patent worthless, but it would take a law suit to convince the manufacturer. If this be true, this road would have saved ten to fifteen thousand dollars by having this matter investigated at the start, saying nothing about what others would have saved that are using this article to-day and are paying the manufacturer whatever he chooses to ask.

The other device referred to can be manufactured by the companies themselves, which is also true of the former article, and has recently come into use and is being used by several companies in large quantities. The patentee is willing that the street car companies manufacture said devices themselves, providing they will pay him a large sum of money for the privilege of so doing—the company already having paid him many thousands of dollars for furnishing said article up to this time. We understand that a similar device has been used by another manufacturer in the past, though for some reason it was not patented. This being true, the patent is worthless, and his demand for royalty would fall flat were the same taken to the courts for settlement. These two matters are still unsettled and are very important to the roads in question, as well as to others who are members of this Association and are using the same device.

Another road, a few years ago, paid over $1,000 in royalties on a truck that was invented by a former employé while working for the road, simply to prevent a law suit, as it would cost more than this amount to have defended the suit. Other cases could be mentioned, but I will not take up your valuable time.

Another important feature in this connection would be the collecting of different patented devices in use on our system, the same to be preserved and open to the inspection at all times of the members of the Association. In short, we might sum up the most important points, as follows:

1. Lessening total expenses in fighting patent suits, etc., as a suit affecting one road would affect all.
2. Uniformity of action.
3. Additional safety in putting on new devices.
4. Greater facility in defending suits, etc.
5. Decrease in number of suits and claims on account of the existence of such an Association.
6. Advantage in settling suits
7. Contending and avoiding unfair and unjust royalties.
8. Reduction of prices on all patented articles.
9. By members refusing to buy articles where suits are brought against any of its members, thus shifting suits to the manufacturer.
10. The dissemination of valuable information to its members of all matters relative to any suit, etc., in which one or more members are the interested parties.
11. Advantage of employés of street railway companies in getting valuable information and assistance on their own inventions, whether patentable or infringement of other devices, without cost to said railway or employé.
12. The acquiring of a full and authentic report of all devices that are commonly found in use on all street railways, such as

1. Presented at the Montreal Meeting, Oct. 16, 1895.

fare registers, brakes, rail bonds and numerous other articles, giving the expiration of all such patents, opinion on the validity of the same, etc., and to be followed up by like reports from time to time, giving list and opinion of new patents, and list of expired patents.

13. The acquiring of models, devices, etc., for permanent exhibition.

In conclusion, your Committee desires to express two plans of carrying into effect the above scheme, and recommends that the Association adopt one of the following methods:

1. Provided the members vote to increase the scope of the Association, we recommend that a bureau be established to handle all matters pertaining to patents as outlined in this report.

2. Provided it is not deemed best to enlarge the scope of the Association at this time, we recommend that the Association pass a resolution providing: That the annual dues be divided into two classes, Regular and Special (or if necessary the By-Laws be amended to that effect). That all members be required to pay the regular dues as already provided in the By-Laws and that it be optional with members to pay the additional or special dues. That members paying special dues will be entitled to all the benefits to be derived through the agency of a patent bureau to be established under the direct control of the American Street Railway Association. That the special dues be based upon the gross earnings of the several roads. That the Association elect a Board of Control consisting of three members, whose terms shall expire in one, two and three years respectively, and hereafter electing one member each year. Said Board of Control to be established and carry on a Patent Bureau as outlined in this paper, with the funds paid into the A. S. R. A. as "special dues." Provided further that no street railway company be entitled to the benefits and privileges of said Patent Bureau, except they are regular members of the A. S. R. A.

Respectfully submitted,

F. R. GREENE,
J. W. MCNAMARA, } Committee.

TAUNTON LOCOMOTIVE MFG. CO.'S SNOW PLOWS.

THAT well-known corporation, the Taunton Locomotive Mfg. Company of Taunton, Mass., is meeting with great success in placing its new snow plows for street railway work. These machines are patented, and exhibit in their construction great care and skill. An unusual amount of study is shown in the design every detail of which has been carefully planned, as if it were for an expensive pumping engine. The builders have been fortunate in being able to avail themselves of the assistance of practical railway men.

The plow is stiff and rugged. It may be given hard usage without injury, and it can be depended upon to stand up to its work in a tight place. Here are some of the principal dimensions: wheels. 33 inches; axles, 4 inches diameter; journals, $3\frac{1}{2}$ x $4\frac{1}{2}$ inches long; main sills, $4\frac{1}{2}$ x 11 inches, of hard pine; total weight, 7 tons, without motors; length over all, 23 feet; wheel base, $6\frac{1}{2}$ feet.

The braking gear is particularly strong and efficient, and brings 1,000 lbs. of pressure on each brake shoe with 25 lbs. at the brake handle. The floor of the house is free of all levers and wheels, because the operating mechanism is at each end of the plow; and large trap doors give easy access to the motors. The motors are on the axles, and motor supports are furnished without extra charge. The diggers can be dropped into place by a kick of the foot, and are lifted by a single movement of a quick-acting lever.

The wing mechanism has called out expressions of admiration from every mechanic who has seen it, because it is simple, strong and clever to the last degree. Each wing is operated independently; and, when folded back and out of use, it is locked in position automatically. The digger and wing mechanisms above noted are applied to the Taunton plows, both nose and share. An inspection of these plows will do more than anything else can do towards convincing an experienced railway man of their merits, and the Taunton Company cordially invites all railway men to visit its shops.

A MERIT SYSTEM FOR DERBY, CONN., STREET CAR MEN.

The conductors and motormen of the Derby Street R. R. will hereafter be assigned their position and work according to their individual standing on the merit system adopted by the company. This system calls for careful running of the cars, prompt work and other minor matters of importance calculated to get the best of service. Those who have the best standing on the list will get most of the work and the most favored runs, while those whose record is not so good will have the less favored positions. Accidents will hereafter, it is hoped, be reduced to a minimum as every man will be doubly careful to keep his record high. Much good will probably result from this system.

"AND SAYING, I WILL NE'ER CONSENT—CONSENTED."

Last week one of the electrical journals said that a special meeting of the stockholders of the Illinois Central Railroad had been called to confirm the decision of the directors to equip their suburban lines for operation by electricity. The further statements were made that the Burnside shops are to be equipped for electrical working and that bids for all of this equipment, both for working the lines and for the shops, had been received. While we have become accustomed to the irresponsibility with which some of the electrical journals make such statements, and while we had kept some track of the Illinois Central plans in these particulars, and were satisfied that there was no truth in the announcements, we thought it well to make special inquiries, as a sudden change of plan might have been made. Our inquiries have been made not only of officers of the Illinois Central Railroad but elsewhere. The sum of the matter is that *the Illinois Central people are considering seriously the possibility of the use of electric motive power in suburban service.* The question is, however, one of great and extraordinary complication, and no plan has yet been worked out by which electricity can be applied there, nor have any bids or estimates been made by the electrical companies, *unless it may possibly be some very general ones as a starting point for further study.* It is not at all impossible that a satisfactory scheme, both mechanical and financial, may be worked out for electrical equipment of these suburban lines; but, considering the immense physical difficulties of the situation, we doubt if such a result is at all imminent. It is certain that nothing definite has yet been arrived at, and that the meeting of the directors has nothing to do with this project. It is also untrue that the Burnside shops are to be equipped with electric motive power. The only electrical equipment there now is the lighting station. All of the new shops will be electrically lighted, *and a few small motors are used to run portable machines for facing-off valve seats. It is not by any means impossible that the use of small electric motors on machine tools may be extended in those shops as is being done in other shops,* but no revolution is in progress there or contemplated.—*Railroad Gazette.*

PRIZES FOR BROOKLYN TROLLEY MEN.

The Brooklyn Heights Railroad company has adopted a novel plan for saving money for the corporation. This is in effect to make its employés co-operate with the company in reducing expenses, not the ordinary operating expenses of the trolley system, nor the acceptance of less wages, but the prevention of accidents by taking greater care of the traveling public. It is well known that juries have little sympathy when trolley companies' suits for damages for the maiming of passengers or for serious so-called accidents on any of the city lines are argued before them in court.

The history of such litigation shows that very high money damages have been sought and obtained; in one instance a judgment against the company for $28,000 was secured. The plan proposed for the reduction of expenses by the company inferentially embraces the proposition to the employés to exercise more care in the future than they have in the past in the handling of the motors in transit. The company has notified the conductors and motormen that a fund amounting to $10,000 has been set aside for their benefit. Those who shall have no so-called accidents from this date until May 1, 1896, will receive a share of the fund; the number of cars having no casualty sharing the fund, share and share alike. The notice also provides that the conductor or motorman who is to share in the fund shall not have been suspended for violation of any of the company's rules. This is the order issued by President Clinton L. Rossiter:

In connection with the new order of this date requiring all conductors and motormen to wear full uniform, the board of directors of this company has authorized the setting aside of the sum of $10,000 to be divided among conductors and motormen as follows:

All conductors and motormen in service this date and who, between now and May 1, 1896, shall have had no accident causing either injury or damage to other persons or property, or to the company's property, and who have not been suspended for violation of the company's rules, will receive on that date a pro rata share of the above sum.

The management desires to impress upon the employés that the success and prosperity of the company depend upon safe, regular and quick car service, together with courteous treatment of the public by its employés and the payment of this amount is authorized in the hopes of securing more efficient and conscientious service on the part of both conductors and motormen and thus improving the service on the company's lines.

"I have received your first 'Data Sheet' and have been interested in reading it. I want to say that I like it, and that I shall be glad to have them as they appear. I enclose a check for sixty cents (60c.) for which please send me a morocco pocket case to hold the sheets." David L. Barnes.

FOURTEENTH ANNUAL CONVENTION OF THE AMERICAN STREET RAILWAY ASSOCIATION.

THE fourteenth annual meeting of the American Street Railway Association was held in the Windsor Concert Hall, Montreal, Canada, October 15-18, 1895. PRESIDENT HURT, of Atlanta, Ga., called the meeting to order at 11.30.

Mayor J. A. Villeneuve, of Montreal, welcomed the delegates, in a brief speech.

COLONEL A. C. STEVENSON, of Montreal, in a speech of welcome remarked:—This is an organization which was severely handled at a meeting I attended last week at Augusta, Ga.—the International Association of Fire Engineers. It seems that you are a dangerous sort of people after all. In one of the papers read we were told that we would not have any water supply, because electrolysis eats away all the pipes, both gas and water pipes, and we will have neither light nor water. That will be a sad state of affairs, I am sure you will admit; but whether it is true or not I do not know. I am sure that if there is any way by which such interference with the gas and water pipes can be averted, you will be glad to employ any means necessary. I hope you will be able to get some means of locomotion which will do away with that idea, so that the running of the cars will not in any way affect the water or gas pipes of the city.

PRESIDENT HURT made his address, in which he said: The street railway problem of to-day is growing in importance more rapidly and is attracting to a study of its solution a greater number of educated men than any other branch of industrial work. But a few years have sufficed to transform a business of dull drudgery and routine in which animal power was resorted to chiefly into a business in which the mysterious power, electricity, but by a distinguished scientist denominated "God's Vice-gerent," works a man's bidding on all sections of an immense system with instantaneous promptness. The usefulness of this subtle force is only equalled by the charm of its contemplation, and the ablest men of the day give homage to a business which invokes its application.

There are in operation to-day in the United States about 179,800 miles of steam roads, and about 13,500 miles of street railways. The passenger receipts on the steam roads the past year were $276,031,000. The gross receipts of street railways in the United States were between $125,000,000 and $140,000,000. The street railway mileage is about 7½ per cent. of the steam railway mileage, and passenger receipts of street railways about 45 per cent. of the passenger receipts of steam roads. The total capitalization, bonds and stocks of steam roads in the United States is about $11,000,000,000, and of the street railways about $1,300,000,000. The latter is about 11 per cent. of the former, while the profits of the steam roads were $322,000,000, and on the street railways about $43,000,000, the latter being about 13½ per cent. of the former. From these figures an idea may be gathered of the magnitude of the business.

There are many questions which call for more extended and complete work. There are new branches of business to be cultivated by the companies, such as the handling of freight and mail, the delivery of small parcels from retail stores through a system of express, the hauling of building material to suburban localities, the handling of milk on special cars for the purpose, and the operation of funeral cars from any portion of the system into cemeteries where special facilities are provided.

The companies will need to lend a mutual aid to each other through the national association for the purpose of defeating hostile legislation in national, state and municipal governments, and to conduct a work all along the line which will tend to implant in the minds of the patrons of the roads the fundamental idea that the public interest demands friendly legislation for transportation companies, since this will tend to enable the companies to furnish the best and most rapid transportation, while harmful legislation will tend to bring about the opposite result.

The relation of street railroads to steam roads is growing more interesting, and in some localities even perplexing, until the question is now being asked, what will be the solution of the extension of electric lines which are cutting so rapidly into the business of the steam roads. A partial consideration of this question brings forth the inquiry—Will not the interests of these two systems of transportation force an amalgamation of the systems, having thereby the main lines connecting distant points, which will be operated into stations at convenient points in municipalities from which passengers will be transported over various street railway lines to their destination?

The steam roads of the country are organized, the territory being subdivided into several sections for the purpose of promoting harmony and mutual protection. While it is true that street railways do not now come into competition with each other, except to a limited extent, yet it is a question if their interests do not demand an organization with sufficient strength and facilities to keep a constant watch over the business throughout the country. It is believed that the time has come when a larger revenue must be raised either upon the assessment plan or by increasing the membership dues.

The great and important question before you here is the one to enlarge the scope of the Association. The Executive Committee has held three long sessions, two in this city and one in New York, the time being devoted chiefly to a consideration of this question. Seven days and nights have been spent in these meetings, the results of which will appear in the Committee's report, and to which your attention is invited.

The report of the Treasurer was read and showed the following result: Receipts, $7,554.57; Expenses, $7,240.55; Balance on hand, $314.02.

Recess was then taken until half-past two o'clock.

TUESDAY—AFTERNOON SESSION.

The first business was the reading of the paper by Mr. E. J. Wessels, on "Air Brakes." [1]

On motion of MR. CONNETTE, of Nashville, the paper was received and ordered to be entered on the minutes.

MR. SCULLIN, of St. Louis: We have had some experience with vacuum brakes. About two years ago we tried two brakes, the Eames' vacuum brake, made by the New York Vacuum Brake Company, and another vacuum brake made by a man in Atlanta. The main trouble with these brakes was in running through crowded sections. Our speed was so slight and we had to stop so often for wagons, that it was almost impossible for us to keep the pressure strong enough to use the brake. We also found that on account of connecting the vacuum brake to the same rod as the hand brake, the hand brake was constantly neglected, and it become almost impossible to use it. In the suburbs we had no trouble in keeping the pressure. Another objection was the fact that we had old motors, and the wiring was different. We had cases where the brake failed to work on account of the wire coming in contact with the piping of the brakes, wearing the insulation off of the wires and short circuiting and burning holes through the pipe. We did not see how we could remedy it.

MR. WESSELS: I would say in response to that question that no air brake is fit to be in service which has not always available a minimum of fifty stops in its reservoir capacity so that if there should not be any movement of the compressor, available power for fifty to one hundred stops is always present, even if the axle does not turn.

MR. WOOD, of Derby: Is there any trouble from the exhaust being sufficient to frighten horses? With the brake on the Nantasket Beach line,—the regular Westinghouse brake—there was a sharp exhaust, the same as with a steam road. If there is anything of that kind, in a crowded street, it would be a serious objection, I should think. Is there any very perceptible noise from this brake?

MR WESSELS: As the paper states, it was not written to advocate any particular type of air brake; but without mentioning names, I know of one brake in which the exhaust has been silenced, and there is no hissing or escape that is noticeable; it has been completely overcome.

MR. SMITH, of Troy: Where is that brake in use? We are anxious to get a good brake.

MR. WESSELS: It would be a violation of etiquette to mention where the brake is in use. The paper was not written for that purpose, but I would be glad to tell the gentleman privately where he may find it in use.

MR. MCCULLOCH, of St. Louis: One of the roads which run parallel with one of our lines was so sure about two years ago that they had everything that was desirable in the way of an efficient air brake, that they equipped a very large electric car, which was large enough to seat fifty-two persons. Everybody was very much pleased with it. The motorman with his little finger could stop the car without any effort whatever. The managers of this particular road were so pleased with the operation of this particular brake that they equipped a number of their cars with it and spent considerable money in doing so. By the time they had ten or twelve cars equipped their repairs began to come in, and they called a halt in the matter. The result was, that no more cars were equipped with air brakes, and to day they have not an air brake in use. They found they could not keep the brakes in such condition that they were always reliable. As I understand it, the trouble arose principally from the fine particles of dust cutting out the packing in such way that there were leaks which could be taken care of only at such expense that it became prohibitory, and to-day there is not an air brake in use in the city of St. Louis, although they had such a splendid start.

MR. WESSELS: In the paper presented the statement was made that there were air brakes entered in the lists at the last convention, which have since disappeared, and the particular type referred to in the paper is the type of which Mr. McCulloch speaks. There were five put in service on the St. Louis and Suburban road, and the management of the road thought so much of the brakes that when the original brakes broke down they rebuilt them and started them again, they realized so emphatically the necessity for having air brakes. The type of brake which is noiseless, and of which I said I would speak of

1. See page 396.

after the meeting is not the type used by the St. Louis and Suburban road. They never tried the brake in question.

MR. SEELY, of New York: There is no doubt about there being a field for an air brake on electric railways. Our great steam road systems are not considered up to date unless they are equipped with air brakes. There is no reason why they should not be utilized, especially on suburban roads. The first experiments may not all have been successful, but there is no reason why they should not be perfected. Our first motors were failures, but we got a motor which does fairly well, and there is no reason why this should not be the case with the air brake.

THE PRESIDENT: The chair is requested to state that Mr. E. P. BURCH, of Minneapolis, who was expected to read a paper on the "Feeder System," through a misunderstanding in not having been advised to read the paper, is here but has no paper.

MR. SEELY: I would like to inquire of the members of the Association their experience regarding street paving. I will state our case specifically:—In building a railroad in a certain city the railroad company is compelled to pave its strip eighteen feet in width with the same material that the city officials pave the remaining portion of the street, which happens in this case to be asphalt. In this street the paving contractor refused to do the paving unless we entirely suspended our service, taking all cars off. They paved one piece, and after that was done, the railroad company decided it would not give up the street. The paving company has refused now to pave that portion of the street, claiming that it could not be done while the cars were in operation, and especially that the concrete would not set, with the cars running over the rails. The railroad company has commenced to put in that concrete itself, keeping the cars moving at the same time. I am pleased to say that it is quite successful so far—the concrete being laid, headers and stretchers being put in, and cars moving right along. Of course, it is expensive. The next problem is, who will pave the top of the concrete with asphaltum? The railroad company is thinking seriously of constructing a plant of its own, and I would like to know if any of the gentlemen present have given up the street, and their entire service, to the paving company to pave a street.

MR. A. LANGSTAFF JOHNSTON, of Richmond: In the work under my charge in Philadelphia, I have done a great many miles of street paving, but we do it under contract. In that city they require you to pave the whole street; not your strip. If the street is one hundred feet wide, you have got to pave it. Our bills amount to a good many hundreds of thousands of dollars. In no case have we given up the street to the contractor. It is a piece of utter contrariness on the part of any contractor who says that he cannot lay the paving without stopping the cars. We put in a concrete paving in and alongside the rail, and did six hundred thousand dollars worth of this work. I did paving also in New Orleans, Philadelphia and Richmond. In Richmond we are going to put in a track laid on concrete, and do not propose to stop one minute for anything.

MR. SEELY: Are you connected with the paving company?

MR. JOHNSTON: No, I am a railroad man. I will say, further, that some years ago I was assistant city engineer in Richmond, and had charge of the paving. That was my work, and the contractors did it there for the railroad companies, and the cars never stopped running a minute. There is no reason in the world why they should.

MR. MCCULLOCH: We pave between our rails and one foot outside, and between double tracks, with the same material with which the street is paved. We are now on one of our roads engaged in just the work referred to. We have two very busy streets, one of them originally paved with asphalt and the other paved with granite, both underlaid with concrete. The men at this minute are working on both streets. The asphalt men are paving, the concrete men are paving and the granite men are paving, and our cars are in constant operation, without any hindrance or suggestion of interference. No contractor or paver ever asked us to discontinue the running of the cars. It would not be tolerated by the Board of City Works in St. Louis. It is not necessary, and is unreasonable on the part of a contractor.

WEDNESDAY'S SESSION.

The Convention was called to order by President Hurt at 10.45 A. M., and went into Executive Session.

The first topic on the programme for discussion, "The Labor Question," was taken up, the discussion being opened by MR. WYMAN, who was followed by Gen. Jackson,

The discussion was suspended to admit of the reading of a communication from MR. BAUMHOFF, of St. Louis, enclosing a paper on Transfers. Both letter and paper were read, and on motion the paper was ordered to be spread on the minutes and printed.

The discussion on the subject of Transfers was opened by Mr. Sargeant, who was followed by Messrs. Charlton, McCulloch, Jackson and Hurt.

During the session an announcement was received that several gentlemen connected with the Dublin Tramways Company were without, having come upon the invitation of the President, and on motion the Chair was authorized to invite the gentlemen to take seats in the hall and participate in the discussion, if they so desired. They were provided with seats upon the platform.

The discussion of the labor question was then resumed, Messrs. Sargeant, Wyman, McCulloch, McClary, Charlton, Hurt, McLean and Connette taking part.

An adjournment was than taken until 2 P. M. The Convention reassembled at 2.15.

MR. HAMILTON then read the report of the Executive Committee together with the amended Constitution and By-Laws proposed by the Executive Committee.

MR. SEELY moved that the Report of the Executive Committee be received and spread on the minutes, and that a vote of thanks be extended to the Executive Committee and Col. Partridge for the report. The motion was carried.

An adjournment was taken until 4:30 P. M. to enable the members to attend a reception given by McGill University.

On reassembling at 4:50 P. M., the Chair accorded to Mr. RUSSELL HARRISON the opportunity of making an explanation, which he desired to make respecting his non-concurrence with the report of the majority of the Executive Committee, upon some items embraced in their report. This was followed by a discussion in which Messrs. Harrison, Hamilton, Jackson, McCulloch, Thompson, Hurt, Cunningham, Wyman and Fairchild took part. Finally, on motion of Mr. Wyman it was agreed that the report as read by the Executive Committee be spread in full on the minutes, that it be printed, and a copy thereof sent to each member of the Association and that action thereon be deferred until the next regular meeting of the Association.

The following resolution proposed by Mr. H. M. Littell was adopted: That a Committee of seven be appointed by the Chair to nominate officers for the ensuing Associational year, said nominations to include nominations for the Executive Committee. Further, that said Nominating Committee shall recommend in their report a place of meeting for the next gathering of the Association, and further that said Committee present their report to the Association on Thursday morning next.

Mr. Harrison moved that a Committee of ten be appointed by the Chair to devise ways and means for raising the deficit of $4000. The motion was carried.

Adjourned until ten o'clock Thursday morning.

THURSDAY'S SESSION.

The Convention was called to order in executive session by President Hurt at 10.45 A. M. The Chair announced the following committees:

On Ways and Means: R. B. Harrison, H. M. Littell, T. H. McLain, W. Y. Soper, H. M. Watson, Charles Odell, Charles Green, E. C. Goodrich, T. C. Pennington and John N. Akarman.

On Nominations: C. D. Wyman, Milwaukee; Charles S. Sergeant, Boston; John B. McClary, Birmingham; W. J. Thompson, Camden; Edward Lusher, Montreal; John A. Seely, New York; Henry Scullin, St. Louis.

MR. WYMAN requested that some other member be named as chairman of the Committee, as he would be obliged to leave Montreal very shortly.

THE PRESIDENT replied that that was a matter which could be arranged by Mr. Wyman with the other members of the Committee.

MR. WYMAN requested that all invitations for the holding of the next Convention be handed to the Committee.

The Secretary read a letter inviting the delegates of the Association to hold the next meeting at Saratoga Springs, N. Y.

MR. MCCULLOCH, of St. Louis, offered the Association the hospitalities of St. Louis for the next convention.

MR. WORTH BEAN spoke in favor of accepting an invitation, from the Chicago City Railway to meet in Chicago

The Secretary read the following communication:

NEW YORK, October 15, 1895.

JOEL HURT, Esq.,
President American Street Railway Association.

Dear Sir:—

Permit me to hand you herewith a copy of the Preamble and Resolutions adopted by the Committee on Standard Rules for Electrical Construction and Operation, of the National Electric Light Association. On behalf of the Association, and the Committee, I most earnestly solicit the co-operation of the American Street Railway Association in this most important work, affecting as it does all Electrical, Insurance and allied interests, and beg that you will as soon as possible appoint a representative from your Association to serve upon the proposed Joint-Committee.

Respectfully submitted,
WM. J. HAMMER,
Chairman.

Preamble and Resolutions adopted by the Committee on Standard Rules for Electrical Construction and Operation of the National Electric Light Association.

September, 1895.

Preamble.

Whereas, There exists at present a diversity of rules relating to the Installation and use of wires for various electrical purposes, and whereas this diversity of rules and the varied interpretations placed upon them unquestionably hampers the general enforcement of such rules, and whereas the time has now arrived when to secure a proper uniformity of, and general observance of, one standard set of rules, a vigorous and concerted action by the various branches of the electrical, insurance and allied industries is of paramount importance, it is hereby

Resolved: 1st. That the undersigned Committee of the National Electric Light Association upon "Standard Rules for Electrical Construction and Operation," acting in behalf and by direction of said Association, do hereby extend a most cordial invitation to the hereinafter mentioned organizations to unite with them in the forming of a joint Committee to undertake the codification, promulgation and enforcement of one standard set of rules which shall meet as fully as possible the conditions that now exist and be acceptable to all electrical, insurance and allied interests.

Resolved: 2d. That in view of the very large number of electrical, insurance and other Boards, Companies, Societies and Associations, as well as individual consulting engineers and experts, who are manifestly interested in, and affected by work of the character proposed by said Joint Committee, and as it will be impracticable to invite all such organizations or individuals to co-operate, it is deemed advisable to limit the invitation to National Organizations and Companies which are practically national in the scope and character of their work.

Resolved: 3d. That in order that the Committee may not be too unwieldy and in view of the considerable number of organizations which it is deemed advisable to invite to co-operate with our Committee, that each organization be requested to send one representative with full power to act for that organization in the preparation of the joint report and which delegate will present said joint report to his organization for final approval and adoption by that body.

Resolved: 4th. That the proposed invitations be extended to the following organizations, accompanied by a copy of these Resolutions:

American Institute of Electrical Engineers,
American Street Railway Association,
National Board of Fire Underwriters,
American Institute of Architects,
International Fire Chiefs Association,
American Bell Telephone Company,
Western Union Telegraph Company,
Postal Telegraph Company,
General Electric Company,
Westinghouse Electric and Mfg. Co.

Resolved: 5th. That the proposed joint meeting shall be held at the city of New York on the date of January 15, 1896.

Resolved: 6th. That the place of meeting shall be hereafter determined and due notice sent to all interested parties.

Resolved: 7th. That a copy of these resolutions be sent to the Electrotechnical, Insurance, Association and Fire Press, together with a hearty invitation to all persons interested in this important work to send to the Committee prior to the joint meeting such criticisms and suggestions as will be of value in the consideration of rules now in vogue and render more complete, thorough and up-to-date the proposed "Standard Set of Rules."

WM. J. HAMMER, *Chairman*,
WM. BROPHY,
HARRISON J. SMITH,
E. A. LESLIE,
JAS. I. AYER,
Committee.

MR. WILLIAM J. HAMMER, by permission of the convention, spoke briefly in support of the request made in his letter for the co-operation of the American Street Railway Association with the National Electric Light Association in securing the adoption of one standard code of rules for electrical construction and operation, and for the appointment of a representative from the Street Railway Association to serve upon the proposed joint committee.

On motion of MR. E. H. DAVIS, of Williamsport, it was agreed that the incoming Executive Committee be authorized to appoint a delegate on behalf of the Street Railway Association.

The chair stated that the next matter in order was discussion of municipal ordinances. The gentlemen who were requested to open the discussion on this question were not present and no discussion was offered.

MR. HARRISON read off the names of the members of the Ways and Means Committee and requested that a meeting of that committee be held immediately. The members of that committee who were present then left the hall with Mr. Harrison, to hold a meeting

On motion of MR. DAVIS, the executive session was declared over and the regular business resumed.

At the conclusion of the executive session, the paper by Mr. N. W. L. BROWN, of Atlanta, on "Ties and Poles"[1] was submitted, and ordered to be printed in the minutes.

The next business was the report of the Committee on Patents. Mr. F. R. GREENE, of Chicago, read the report.[2]

On motion of MR. RIGG, of Reading, the paper was received and referred to the incoming Executive Committee.

MR. SEELY offered the following resolution:

Whereas, It is the purpose of the National Electric Light Association to hold in New York City next Spring at its annual convention, a comprehensive exhibit of modern electrical inventions and applications depending on the use of central station and power house current, with the object of increasing popular interest in electric lighting and allied arts, and

Whereas, It is the desire of the American Street Railway Association to promote on the part of the public, particularly in all large cities, a fuller and more intelligent appreciation of the great benefits that accrue from electric light, heat, locomotion and other modern triumphs of civilization,

Resolved: That this Association hereby expresses its cordial sympathy with and approval of this plan for the furtherance of electrical development, and for the enlargement of the sphere within which electricity is to perform its beneficent work.

MR. DAVIS, Williamsport: I desire to say a few words in regard to the resolution just read. The National Electric Light Association intends to hold an exhibition in connection with its next annual meeting to be held in New York City, in May or June of next year. The exhibition will be held under the auspices of the National Electric Light Association, but is to be given in the name of a company formed specially for that purpose, with a sufficient capital to make the exhibit of far more than ordinary interest. I understand that the object is to include in that exposition electrical appliances applicable to street railways as well as appliances applicable to the electric lighting business. The resolution is simply intended to interest the members of this Association in that exhibition.

The resolution was adopted. The meeting then adjourned until two o'clock.

THURSDAY AFTERNOON SESSION.

VICE-PRESIDENT CUNNINGHAM called the meeting to order at 2:30 P. M.

The report of the Committee on Ways and Means was presented by the chairman, Mr. Harrison who stated that voluntary subscriptions had been canvassed, and in the space of an hour and a half nearly two thousand dollars had been subscribed.

REPORT OF THE COMMITTEE ON WAYS AND MEANS.

Pursuant to the appointment by the President of the Association, Joel Hurt, the following members of the Ways and Means Committee met this day in room No. 1, Windsor Hotel, at 11 30 A. M.: President, Russell B. Harrison, Charles Green, T. C. Penington, H. M. Watson, John N. Akarman, H. M. Littell, Charles Odell, E. S. Goodrich, Thomas H. McLean and W. Y. Soper.

Your Committee recommend that the several members of the Association be requested to contribute a sum not less than fifteen dollars each to liquidate the floating indebtedness of the Association, amounting, as stated in the report of the Executive Committee, to the sum of $4,067. Your Committee believe that the amount thus realized, together with the net revenues to be derived from the rental of space in the Exhibition Hall, will be sufficient to pay all present indebtedness.

And your Committee in order to prevent recurrence of any deficit further recommend that the practice heretofore established of giving to the members of the Association banquet tickets, be discontinued, and that hereafter a uniform charge of five dollars be made for such tickets.

Your Committee recommend the adoption by the Association of the proposed amendments to Article 3 of the Constitution, and Article 7 of the By-Laws, introduced at the Atlanta meeting of the Association, which proposed amendments received the unanimous approval of the Executive Committee and the Association itself at the Atlanta meeting, as appears by reference to pages 119, 120 and 121 of the report of the Thirteenth Annual Meeting, which proposed amendments are as follows:

CONSTITUTION.

Members.

Article III. of the Constitution shall be amended, so as to read as follows:

Section 1. There shall be two classes of members—active and associate.

Section 2 Active members shall be American Street Railway Companies, or lessees, or individual owners of street railways, and each member shall be entitled to one vote by a delegate presenting credentials.

Section 3. Associate members shall be individuals or firms, or companies, not embraced in Section 2, who have been recommended by an active member. Associate members shall not be entitled to vote.

By-Laws. Meetings.

Article II. shall be amended by the substitution of the word "Tuesday" for "Wednesday," and by the addition of the following words to the first sentence, namely: "and shall continue four days."

Respectfully submitted, Russell B. Harrison, H. M. Littell, John N. Akarman, H. M. Watson, E. S. Goodrich, Thos. H. McLean, Secretary; T. C. Penington, Chas. Green.

MR. HAMILTON: I feel that this committee is deserving of the thanks of this Association, and I would move that this report be received and entered on the minutes.

MR. THOMPSON, of Camden: There is one thing predicated on the matter, which I do not like. Am I correctly informed that the payment of this money is predicated upon a certain state of facts reported, in other words, if you do not adopt the resolution, the money does not come?

MR. HAMILTON, of St. Louis: I would like to draw attention to an error in it. This report is based upon the assumption that the deficit is $4,067. As stated when the report of the Executive Committee was read, the four thousand dollars is for past indebtedness, and does not include any of the bills for the banquet and other expenses here. This report assumes to take the profit realized on the exhibition for the past indebtedness. We have in the neighborhood of two thousand dollars of expense here, in addition to the other, which will make it amount to over six thousand dollars. You are starting out, assuming that you are going to relieve the incoming executive committee by raising that amount of money and using part of the assets which the present committee must have, in order to apply it on indebtedness incurred. I want the members to understand how it is.

MR. HARRISON: The committee believed that from the way we have received such liberal responses up to the present time, we will raise a larger sum than four thousand dollars. They also believe that by the adoption of the report, providing for associate members, that it will bring to the Association for the coming year from $7,500 to $10,000, over and above the annual dues that become due and payable on the adjournment of this convention, which will be from 175 companies, or in the neighborhood of thirty-five hundred dollars, giving the Association more funds than it has ever had before in its history, and putting it on a substantial basis, financially.

MR. THOMPSON: Now we can discuss this matter intelligently; it is a question if you street railway men who are putting up your money and investing it in street railways, are going to permit outsiders to come in and put up their money and run your Association. That is the size of it. I think the street railway companies that are represented here are able to discharge the debt. All that need be done is to say, "We will charge you in proportion to your income," and let them levy it right here, without having a subscription. Admitting the voluntary subscription

1. See page 394.
2. See page 398.

to be all right, to predicate it upon the adoption of something else, to my mind—and I say it very plainly—is the worst thing you can do. We have the greatest amount of respect for the material men; but we do not want them as members of this Association. That is the plain Anglo-Saxon of it. If this is to be an Association maintained by American street railway companies, let them maintain their organization and pay the reasonable and legitimate expenses for the diffusion of knowledge that will be a benefit to the parties concerned. If the parties who sell material want to come here and show their exhibits, and call attention of the delegates to the proper running of the road and the proper parties to buy of, who has the best equipment at the most reasonable price, that is the proper thing. But if you permit these gentlemen to come in here and talk, they will certainly have a great influence upon the voting power, and with small roads, having an equal voice in the Association, they might exert considerable influence, in shaping the votes of the members. The report of the committee shows certain subscriptions; if there are not enough there, ask the railroad companies to contribute so much more, but do not predicate it upon the adoption of these resolutions. While my road is a small one, we are willing to pay an extra hundred dollars, and I will say now put that down on the subscription list, but not in the way in which it is done.

Mr. Harrison: I stated clearly as chairman of the committee that some of the contributions were received with conditions and some were not. As to the gentleman who has just spoken, he made his without any conditions, but there are others who made conditions, among them the president of the Association. We proceeded to receive voluntary subscriptions approximating $2,000, and intended to continue our work and before the convention adjourned secure the full amount, $4,000, and probably more. We are not recommending the adoption of any by-laws that have not been thoroughly discussed by the members of the Association. Everyone has received a report of the last meeting, and in that report it is stated definitely that the by-laws recommended received the approval of the Executive Committee at the Atlanta Convention, and also received the unanimous vote of the members. We do not propose that the supplymen shall run this Association. We have denied them the right to vote. The report, we believe, should be adopted by this meeting, because it brings to you relief that you require. We cannot exist without the supplymen and they cannot exist without us, and why erect a barrier between us, and say that they cannot come to our meetings, when we are taking a thousand dollars from them for the space in the exhibition hall. Is it right or fair? No one can say he is taken by surprise by this matter, as it has been before us for years and was voted on at the last meeting.

The motion of Mr. Hamilton to receive the report and spread it upon the minutes was put and carried.

Mr. Akarman, of Worcester: A few words as to the fallacy of the argument of the gentleman from Camden. He said that if supplymen became associate members of the Association, we will lose control of the affairs of the Association, by reason of their being made active representatives of the Association. If my understanding is correct that same thing could apply now. There is no reason why a supplyman cannot come here as the accredited representative of a street railway company. I know, as a matter of fact, that there are supplymen here in this hall who have a right to vote and to participate in our deliberations, coming here as the representatives of street railway companies. The intention of the committee, as I understand it, being one of its members, was not to make it a condition of the subscription that the supplymen should become members of the Association. I did not subscribe with that idea, but I think it would be no more than fair to admit the supplymen. We owe a great deal to them. The inception of this Association was brought about by them. It began at Boston through the efforts of Walter A. Jones, Mr. Brill and one or two other supplymen, who had been about the country and were well acquainted with the railroad men, and suggested the idea of forming this Association. I have always felt that we treated the supplymen very shabbily. The committee had in mind, as far as I could see, and in the discussion which was had, that the convention last year had practically passed upon this matter—that it had been canvassed and passed by last year's Executive Committee and by the Association, and was a proper subject to bring up at this time; but if it is not the sense of the Association to admit the supplymen, I will not feel bad about it. I am honest in my belief that the supplymen contribute largely to the success of the conventions, and I think they should be admitted to associate with us.

Mr. Harrison: A member of the Committee has requested me to make a further explanation. Mr. Thompson did not say so exactly, but drew the inference that we proposed to take in the supplymen to pay the debt. The first thing the committee voted upon was a proposition that the street railway men come forward and settle the debt, and leave the entire revenue received from the associate members to go to the work of the Association: in other words, we do not ask them to help pay our debt in any way.

Vice-President Bean in the chair.

Mr. Hurt, of Atlanta: I did not propose to say anything on this report, because from the very generous way that the gentlemen propose to raise the debt, I had no doubt they would do it. I must confess, however, that I am disappointed in the report submitted. It is not what I supposed would be submitted. I have been referred to as one of the subscribers attaching a condition to his subscription. I will state some of the history of this matter. I was approached to know if I would subscribe something. I said, "Yes; on what basis?" "Any sum not less than fifteen dollars," said the chairman of the committee. "Do you hope to raise enough money on that basis?" "Yes." "I do not think you will: let the scheme be sufficient to pay off the debt, and I will join you." In a half hour or so, I was invited to the room of the committee and requested to sign a subscription blank presented to me for $50. The heading recited that the companies below proposed to subscribe the amount set opposite to their names for the purpose of liquidating the debt of the Association. I have been in enterprises of this sort, proposing to raise so much money and failing. I said if they would leave off the heading, as it read, and make it read, that the undersigned would raise sufficient funds to pay the debts of the Association, I would sign it. There are twenty-four names now, each subscribing $50, and I said let the names stand, that we propose to subscribe enough to settle the debts. But the committee has come here with a partial report, supposing that others will subscribe the amount.

There is a Trojan horse in this report: if it is adopted it will mean the dissolution of the Association. I have been attending these meetings regularly, have received a great deal of benefit, and want to receive greater benefit. I submit that the gentleman meant every word when he said that the report was presented on the idea that you would adopt these recommendations for the amendment of the by-laws. It is the same proposition that for two days has been before the Executive Committee, and the reason for the delay in the report. I will gladly sign a subscription "to pay the debts of the Association," if it is put in that way.

Let us have a word about the supplymen. I believe I am as good a friend to the supplyman, so far as concerns the purchasing of supplies as any man here. I know a good many of the supplymen, and to their credit let me say that I do not know but one man who desires to be a member of the Association. They do not want to come in, they know it means the death knell of the Association and injury to their business. These supplymen are gentlemen and respect their business, and they know that to come in here and interfere with family matters will be to their disadvantage. If you will allow me to refer to our Atlanta meeting modestly—Mr. Fairchild will bear me out—and I want to say for Mr. Fairchild, that the success of this Association is largely due to his efforts; I have not said this heretofore,—at the Atlanta Convention we had a large crowd and the finest exhibit ever held at the Association meetings. In his travels in the south, east and west he drummed up that meeting more than anybody else, and the credit of the success of the meeting was due very largely to the work done by him. It was known that the supplymen would be given an opportunity to exhibit their goods and were not going to be put in a corner, where occasionally a railroad man would wander over to their stands, but were put in the front rank, so that when the delegates came into the hall they had to walk through the corridor of the supplymen. I am very grateful for the expressions received on all hands that it was the most successful meeting from the standpoint of the supplymen ever given.

If we should adopt this amendment, there are probably half the members who would not come here and expose their business to supplymen in secret session. If the Association means to have any respect for itself and means to be an institution for the good of its members, let us meet this question like men. Do not let us go around pleading poverty and the baby act. Do not let us come here and say we will raise the money, and then come back with a proposition to raise $2,000, upon various conditions, and the balance we are going to ask our brethren all over the country to subscribe in sums over fifteen dollars each. For one, I am here with you and propose to stay with you to fight this matter out and help build up this Association and sustain it as long as we can, hand in hand, against the common enemy. If I know my enemies, I am not going to ask them into my household and give them equal rights with myself. Even though they cannot vote, they can talk; there has been lots of it done since I have been here.

We should study this matter carefully and view not so much the amount of money involved, but look more to the future welfare of the Association. The question is whether you are going to have the Association preserve its dignity and be of benefit to its members, or whether you intend to have a junketing affair, as it has been somewhat in the past; and which will lose you lots of members. I have had enough junketing. I am anxious to meet the delegates, to have a banquet, but I do not want to call upon the supplymen to pay for the banquet. This committee is in favor of each man paying for his own ticket, and in favor of the supplymen paying no more for a ticket than anyone else. If the supplyman is our guest, he ought to have the ticket for nothing. I will pay one-twentieth, if you will raise the amount

of the whole debt but do not propose to pay one cent, unless you raise it all. I do not propose to leave it as an inheritance to the Executive Committee that you will elect to-day.

The amendment says that "Associate members shall be individuals or firms or companies not embraced in section 2;" just see how broad! It will include every one in this room, and any kind of business firm or establishment in the whole world besides. Who ever heard of such a proposition? Let us invite the whole world to join us. The section further says "who have been recommended by an active member." I could bring you fifty applicants inside of a week, recommended by an active member, and not one of them would have any business in this room. Here is the great saving clause (?)—"Associate members shall not be entitled to vote." They will fill this hall three times over, and you cannot tell who is voting. You will have no more executive sessions. You will not get men to talk out. See how quickly the change came yesterday. I had not heard what was said in the executive session of the meeting yesterday, and requested that the discussion should be printed and sent to each member of the Association, confidentially. It was passed, but as soon as the members reassembled, the motion was rescinded. "I do not propose to talk on the floor," said one of our important members, "if you are going to publish it to anybody; you can hear it, but I do not want it published."

MR. HARRISON: I tried to make my position as a member of the executive committee clear to all. It was that I believed we should take up and act on the proposed amendments to the Constitution. These amendments had the approval of the last executive committee and also the ratification of the Atlanta Convention and I thought they should be disposed of at this meeting. The executive committee simply ignored them. This was my position, and I have endeavored to make it clear. I am under no obligations to the supply men, but was committed to the extent of having the matter brought before this convention for action. In the report of the ways and means committee which has been presented we have made a recommendation to prevent further deficits. We certainly do not want the supplymen to pay our debts and run this convention. We do not intend that they shall do that: but as long as they attend our gatherings and we depend upon them for the most interesting feature of the convention and receive a thousand dollars from their Montreal exhibit to help us along, the committee thinks they should in some way be connected with us. We believe that the adoption of the report will give the Association the revenue it so badly needs to enlarge its field and scope. The National Electric Light Association has associate members, and raises a large revenue. The supply men do not annoy them. I have been a member of the Institution of Mining Engineers for many years, with a very large membership, of which the greater part are associate members. We can therefore follow the successful experience of kindred organizations.

As to the plea that we need secret meetings, I would state that I have not attended many meetings, but have attended enough to know that there is no discussion, action or paper presented to this convention that does not find its way into the technical press, accompanying a general outline of all the business we transact. I said to the executive committee of the Association while in session that I believed there was something radically wrong with our organization, that while there is a very large number of street railroad companies in the country, we have only 166 members; and as a remedy I urged that we should make the meetings so interesting by the reading of papers, by our exhibit, and in some other ways that all would join. I do not believe that there is any necessity for secret sessions of this Association. If there should be great necessity at times for executive session, we have that privilege under the Constitution and By-Laws; but that is no reason for excluding the supplymen from membership in the Association for so unimportant a reason. If they want to find out what has been done in any of our so-called secret sessions they can do so from some member present, just as the reporters do in the United States Senate, when it has meetings with closed doors. This is particularly true when we have supplymen here voting as representatives of street railway companies, and who are here in a dual capacity. We admit them under such circumstances; why not admit all, and place this Association on a solid financial basis?

I will give as much time and as much money as any member of the Association towards its success. The Committee has made the recommendation as to associate membership for the welfare and good of the Association.

MR. GREEN, of St. Louis: I am sorry that questions of this kind should come into this Association. I have attended almost every meeting, and we have never had any discussion about financial matters, or about supply men or any other matters which would tend to disrupt the pleasant memories we have had for fourteen years. When this convention was organized, or shortly after, when the meeting was held in St. Louis, there was no question about banquet tickets or supplymen. The St. Louis railroad companies paid for the banquet and the entertainment of the members of the Association. There was no question about five dollars from this one, and that one; we brought them there and entertained them and paid all the expenses, and we will do that again, gentlemen, if you will come.

As to the supplymen, there would not be a corporal's guard in this convention but for the supplymen. They spend their money and are the life and soul of this convention. You find them in the convention headquarters, with a big roll of bills, spending their money, and bringing their exhibits here and putting them in the hall at enormous expense, to show you the latest developments in the street railway business, and it does not cost the members a cent. They supply our material, and build our roads, and are willing to take our bonds, and why in the name of common sense do we not want them with us? They have attended every convention since the beginning. We are not calling upon them to pay our debt. That will be wiped out before these gentlemen are to be taken in. It is to be provided for by subscription among the members of the Association, and not by the supplymen. Some man here that has a road making perhaps, two or three hundred thousand dollars a year, subscribes fifty dollars, and there are others representing roads with an income of several million dollars, and they only subscribe fifty dollars; that is not right or just. My name is down for fifty dollars, and my road does not earn three hundred thousand dollars. Shame on these men, and then they come and tell you supplymen should not be admitted. The supplymen started the convention, if the facts were known. What would there be in the Victoria Rink, if the supplymen were not here. They come ahead of the meeting and stay after we are gone, and to their credit be it said they pay their bills all the time. I want this report adopted, and adopted unanimously. If you exclude these gentlemen, who are the mainspring to this convention, good bye to the American Street Railway Association. You will make a serious mistake if you reject the report of the ways and means committee.

MR. MCLEAN moved the adoption of the report.

MR. SEELY, of New York: I will give one hundred dollars, without any condition. I build railroads, and I sell them; you all do it, you are all supplymen. I am with the supplymen, or I am against them, according to circumstances. When Mr. Thompson spoke, I was confident he was not aware of the condition of affairs in this Association. I am sure he has the greatest respect for all supplymen, but he objects and so do a great many of the members of the Association to being forced to subscribe to a fund upon conditions. I subscribe one hundred dollars to a fund for liquidating the debt, without any condition whatever. How many in this Association will get up and subscribe without any condition?

At this stage Mr. Seely's proposal was discussed, changed, and finally taken up in such a way that within half an hour the roads represented on the floor had subscribed $4,475, with privilege to others to come in; but the report of the Committee on Ways and Means was tabled by a vote of 87 to 11.

THE NOMINATING COMMITTEE presented the following recommendations for officers for the ensuing year:

For President, H. M. Littell, Brooklyn, N. Y.; *First Vice-President*, Granville C. Cunningham, Montreal; *Second Vice-President*, William H. Jackson, Nashville, Tenn.; *Third Vice-President*, J. Willard Morgan, Camden, N. J.; *Secretary and Treasurer*, T. C. Pennington, Chicago, Ill.; *Executive Committee*: Joel Hurt, Atlanta, Ga., Prentiss Cummings, Boston, Mass., C. G. Goodrich, St. Paul, Minn., A. Markel, Hazleton, Pa., W. F. Kelly, Columbus, O.; *Place of next annual meeting*, St. Louis, Mo.

The Secretary cast the ballot, and the gentlemen were declared duly elected.

THE PRESIDENT: The next business will be a report of the Committee on the use of Salt and Sand on street railway tracks.

The committee read the following report:

Your Committee appointed to report upon the necessity for the use of salt and sand upon street railway tracks during the winter, in order to remove ice and snow, and make the running of cars safe and practicable, begs to submit the following report:—

The use of salt on the rails at certain times and during certain conditions of weather is absolutely necessary in order to clear the rails of a film of ice that will otherwise form on them. Without the use of salt it would be very unsafe to operate cars on a hilly system during winter and your Committee is of opinion that no road can afford to dispense with its use. Salt has been used on street-railways throughout the United States constantly while horse cars were in vogue, and now more than before is its use imperative in the operation of electric cars.

In like manner, sand is a necessity on the rails in order to give the wheel a "proper grip" on the track.

In the city of St. Louis, Mo., the quantities of salt dumped on the tracks is in excess of three thousand tons in the course of one winter. There is no objection on the part of the local authorities or health board, to its use, and but for the use of this salt, it would be impossible to operate our cars. The use of sand is also absolutely necessary, and its use is not interfered with in any manner, any more than is the use of salt.

D. G. HAMILTON,
ROBERT MCCULLOCH.

On motion of MR. MORGAN, the report of the committee was ordered to be received and printed.

VICE-PRESIDENT HARRISON in the chair.

MR. THOMPSON moved a vote of thanks to the President, Vice-

Presidents and the Members of the Executive Committee for the able manner in which they discharged their official duties.

Carried.

MR. HAMILTON moved that the thanks of the Convention be extended to Mr. E. E. Higgins, who had so efficiently acted as Secretary during the Convention.

MR. HURT: I rise to second the motion, and to make a statement. The Executive Committee found itself in a position not to justify the employment of an efficient man to perform the duties of Secretary. I saw the situation that things were in owing to the illness of Col. Partridge, and about six weeks ago visited New York and conferred with him, and canvassed a number of names to get some one to do this work; we also visited Mr. Higgins and others. I returned home without having obtained the consent of any party. I wrote and telegraphed Mr. Higgins, and I desire to say that in answer to earnest entreaties he consented to serve the Association on the stipulation that there would be no compensation tendered to him.

The vote of thanks to Mr. Higgins was unanimously carried.

MR. HURT: I move that a committee of three be appointed to draft and include in the proceedings of this meeting a suitable resolution of thanks to the citizens of Montreal who have so hospitably entertained us. Carried.

The chair appointed MESSRS. WATSON, HAMILTON AND E. S. GOODRICH.

MR. HAMILTON moved that the report of the Executive Committee be made public. Carried.

REPORT OF EXECUTIVE COMMITTEE.

The report of the Executive Committee was a long and exhaustive document, going into a great many details as to the work, relations and status of the Association, and dealing with the somewhat disorganized state of affairs resulting from the death of Mr. W. J. Richardson, in spite of the efforts of Col. John Partridge. It appeared from the report that a floating debt of $4,087 had accumulated, partly from the expenses of the annual convention and partly from the practice, it would seem, of paying the officers their expenses incurred in attending the sessions of the committee during the year. The question of enlarging the scope of the work of the Association was also touched on, and the draft of a constitution was submitted, the main feature of which was the limiting of the membership strictly to American Street Railway Companies, each road having one vote.

MR. HARRISON: As chairman of the committee appointed to devise ways and means, I desire to say that I consistently and persistently followed what I deemed to be a proper course of duty. The convention has made a decision on that question, and the chairman of the committee accepts the decision with perfect good feeling for every member of the Association; and I believe I have the right to say that I express the sentiments of all the committee. I have not had time nor opportunity to confer with it, and in the absence of the gentlemen I will state to the convention that they accept this decision as settling that matter, and that we congratulate the Association upon raising the money which will result in wiping out the debt; and for your courtesy and kindness to me aside from my duties as chairman of the committee, I thank the convention. I hope in the future that my relations with the Association will prove that while I differ from a majority on one point, I am loyal to the American Street Railway Association.

Adjourned until Friday morning at 10 o'clock.

FRIDAY'S SESSION.

THE PRESIDENT called the meeting to order at 11 o'clock, and stated that the regular order of business called for an executive session.

MR. SCULLIN, of St. Louis, moved that the session be declared an open one. Carried.

THE PRESIDENT announced the subject of "Furnishing Free Music and Other Entertainments by Street Railway Companies to the Public," to be in order.

MR. MCLEAN, of Indianapolis: The Citizens' Railway Company owns the only park of any size in the city of Indianapolis, which comprises 265 acres, and we find it very profitable during the summer to give entertainments there, particularly in the way of band concerts, and they have attracted many thousands to the park especially Sunday afternoons and evenings.

MR. MCCLARY, of Birmingham: We have a park of about one hundred acres, with a lake 33 acres in size, with pavilion, walks and drives, and every weekday night except Saturday, during the summer, we have a band playing music for dancing. Every Sunday afternoon we have a sacred concert, and find it profitable.

THE CHAIR stated that the gentlemen who had been requested to prepare papers to be read at this meeting, and to take part in the discussion, had been notified so late that they had not been able to get the time to give the subjects proper thought. This was partly due to the illness of the Secretary, pro tem.

MR. SCULLIN: I would like to ask if it is not a fact on account of these large crowds congregating at one point, and all being desirous to get away in a short time, there is not a greater liability for accidents, especially in putting on extra cars and allowing green men to handle them. I would like to ask the gentlemen who have spoken on the subject if they have had any such experience.

MR. MCLEAN: So far as our road is concerned, we have been free from accidents at these unusual gatherings. We had the Encampment of the State Militia in our park this summer, which resulted in a very handsome gain in receipts, and it taxed our facilities to the utmost to carry the people to and from the park, during that week and there was not a single accident.

MR. MCCLARY: We have never had an accident in carrying away these crowds that collect at the parks on account of these entertainments. For two years we have had the State Militia encampments and had as many as eight thousand people at a time in the grounds, to bring away at one time, as soon as we could get them away and have never had an accident.

MR. HURT: As the result of special inquiry on that very point I have gathered the impression that during the time that large crowds gather for pleasure at resorts of this kind every one is on the qui vive, so to say, and there are fewer accidents and less disposition to make complaints to the companies; and if an accident does occur we are less liable to hear from it than on ordinary occasions.

MR. PENINGTON: I understand that in Chicago on "Chicago Day" at the World's Fair we carried eight hundred thousand people, and the most serious accident we had was that some one shoved a man off a car and hurt his arm. The cars were crowded so that we could not make a pick up from one car to another, on account of the fenders rubbing on the ground. The next day we did better, but there was no riding of any account. It seems at a time like that as if everybody was on the lookout and avoided danger.

MR. J. F. MCELROY addressed the meeting on the subject of Electric Heaters for Street Railway Cars, illustrating his remarks with a number of diagrams. The paper was an expansion of the admirable one recently printed in our pages.

On motion of Mr. Harrison the meeting passed a vote of thanks for the remarks; and requested Mr. McElroy to revise and amplify them for publication in the proceedings of the meeting, with the diagrams accompanying.

The COMMITTEE ON RESOLUTIONS presented the following report:

Resolved, That the American Street Railway Association in Convention assembled expresses the heartfelt appreciation of its members of the many acts of hospitality and courtesies extended them by the citizens of Montreal and by the officials of the Montreal Street Railway Company; and that we give assurances to both of a grateful remembrance. We came among them as strangers and found in their homes and hearts a heart welcome and a love corner—a greeting long to be remembered; and the separation which now comes will be long regretted.

To one and all we extend a hearty invitation to our next meeting, where we hope to extend our best welcome.

H. M. WATSON, D. G. HAMILTON, E. S. GOODRICH.

On motion, the resolution was unanimously adopted.

The chair appointed Messrs. HAMILTON and HARRISON a committee to escort the newly elected President and Secretary to the platform.

They were duly installed and acknowledged their election with thanks; and pledged their best efforts in the development of the Association.

The meeting then adjourned, to meet in St. Louis, the third Tuesday in October, 1896.

CONVENTION NOTES.

MR. GEO. F. PORTER was present at the convention in the interests of the National Electric Light Association, and was much gratified with the reception given to the resolutions in favor of the proposed exhibition to be held in New York next spring. There was a general feeling among the street railway men that the exhibition would do much to remove the unreasoning prejudice still felt by many people against the modern advances of electricity.

MR. E. E. HIGGINS deserved the hearty vote of thanks given him by the Association for the work done by him voluntarily and cheerfully in the position of acting secretary. A great many men would have declined any connection with the work of the body at this juncture; but Mr. Higgins acquitted himself with admirable nerve and judgment, and became a rallying centre for all the good influences of the occasion. If Mr. Higgins ever put in a more tiring and concentrated week, it has escaped the notice of his contemporaries.

THE SPECIAL TRAINS.—It is needless to say that all the special trains were well patronized, no matter what direction they came from. The New England party on its way up did the White Mountain scenery and arrived, some sixty strong, on Monday evening. A large party from Chicago by special train over the Wabash had a very pleasant time. Mr. C. W. Price, with the powerful aid of no less a personage than Mr. Roach himself, handled a very big special to and from Montreal, over the Adiron-

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EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of* The Electrical Engineer. *Communications for the attention of the editors should be addressed,* Editor of The Electrical Engineer, 203 *Broadway, New York City.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

THE OLDEST ELECTRICAL JOURNAL IN AMERICA.

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CONTENTS.

THE MONTREAL CONVENTION.

THE influence and weight of such a body as the American Street Railway Association, when it is properly administered, cannot be gainsaid. Its membership has always been of a substantial character, its work has in the main been useful, and it represents an enormous investment every cent of which is devoted to the promotion of the general prosperity. The industry it speaks for has not a single element of evil in its composition, and panders to no individual vice or source of public degradation. It stands for cheap transportation, clean streets, unmortgaged homes, the diffusion of wellbeing and the enjoyment of new and innocent pleasures by millions of city toilers. Anxiety for the welfare of an organization so representative needs therefore no explanation on the part of those who, through the press, deal with the various technical, industrial and social sides of the art; and it may be taken for granted that the reluctance to criticise the Association management will only be overcome by a desire for higher efficiency in an agency so potent for results.

Last year the convention at Atlanta exhibited many detrimental features, and we could not refrain then from an expression of the fear that unless things were soon mended, the Association itself would be ended. The condition of affairs revealed at Montreal is proof of the accuracy of the views which we ventured to put forward last October; and there is no need for wonder that many earnest men have offered conflicting remedies for the evils to be dealt with. The Montreal meeting, held under most favorable circumstances, was far below the average in many respects, and everybody who attended was sensible of a numbness and apathy very different from the vigor and swing of previous gatherings. As a matter of fact the time had come for a halt and a right-about-face; and now that the maladies have been seriously grappled with, we believe the Association will emerge from its recent ordeal, stronger and better in every respect.

We confess to a sympathy with Mr. Russell Harrison in his disinterested endeavor to secure for the supplymen some formal recognition. It was they who created the Association; they who have brought accessions to its membership; they who have fostered it; they who make its exhibitions; they who have swelled its annual gatherings until every city is impressed with the magnitude of the industry; and they who have contributed to the technical value and importance of its transactions. Yet they have been treated as pariahs, as hangers on, as camp followers, as interlopers; and many a supplyman has had heartburn over the situation. The Association adheres to its original formation, but it seems to us it might at least have gone as far as the National Electric Light Association in admitting to its fellowship, but without vote, men so vitally interested in the growth of the industry. There is not a technical society to-day that does not accept in its associate membership the men who honorably represent the commercial side of the art for which the society is sponsor; and the A. S. R. A. could well afford to show that it has respect for brains as well as dollars and bonds. Be this as it may, so long as hosts of supplymen can enter its membership by representing street railway companies —as they do—its present constitution will be a mockery.

and a fraud. If it wishes to be absolute in its fundamental principles, it should rule that no man interested in any supplies of any kind should have admission, a voice or a vote. We are painfully surprised to find so clearheaded and straightforward a man as Mr. Hurt saying that he knew of only one supplyman anxious to enter the Association, when the benches before him were full of supplymen in the role of street railway representatives. How he could stultify himself to that extent passes our comprehension. To use his own simile—if horse similes have now any utility in an electric railway gathering—the Trojan horse is already within the walls. Another curious contradiction of Mr. Hurt's statements is the fact that many of the best papers are contributed by supplymen, who yet as such are not to be tolerated within the gates.

However, the Association has lifted its debt, put good men in control, elected a capable secretary and cleared away a lot of the debris of the bygone rapid times. It is now in better shape than for years past to do its duty, and everybody will wish it abundant success.

One fact stands out above all others in connection with the Montreal meeting and that is the emphatically electrical character of the Association. It is fully as electrical as the N. E. L. A., and the cable and horse car men have literally dropped out of sight. This being so, we think it would have paid the convention to discuss many of the engineering questions pressing for solution and that will not down. The subjects of brakes, of ties and poles and of heaters were well handled, but of the new topics of underground wires, underground trolleys, closed conduits, the relations of motor and truck, etc., there was not a word, in spite of the fact that the convention lasted from Tuesday until Friday, inclusively. More than half the time was wasted in stupid "executive sessions" to which some two hundred people had access, reminding one of the secrets that are whispered to the winds and waters; and it does strike us as rational to expect a better showing for so much time, money and trouble at the annual meeting of a society which represents a capitalization of $1,300,000,000. We venture to hope, nevertheless, that the corner has been turned and that the convention at St. Louis will be the best and most useful that the Association has ever known.

ETHERIC LIGHTING.

Stimulated and encouraged by the results produced by Mr. Tesla in obtaining phosphorescent vacuum tube lighting by means of currents of high frequency and high potential, inventors have taken up this work and results are already beginning to manifest themselves. In the path marked out for himself, Mr. D. McFarlan Moore has confined his efforts to the production of effects by the employment of comparatively low potentials intensified, however, by the abruptness of the impulses. The method of securing the desired abruptness of breaking of the current by placing the interruptor in a vacuum is an exceedingly simple expedient, which gives Mr. Moore's system one of its principal claims to recognition. The effects already obtained with the Moore apparatus, some of which we have witnessed, give promise of success in the creation of a practical illuminant for general purposes; but even in its present condition the system already possesses unquestioned commercial value.

FRANKLIN LEONARD POPE.

The death of Franklin Leonard Pope and the circumstances attending it will bring grief to the hearts of all whose privilege it was to meet him personally, and to that larger number by whom he was known only through the medium of his pen. A man of sterling qualities whose position in life was attained by his own unaided efforts, he ever retained that sincerity of purpose and honesty of character that stamp nature's true nobleman. Of his ability in the several domains of work towards which his attention was attracted, his uniform success in nearly all is sufficient demonstration; but it is more particularly of his influence on electrical journalism in America that we desire here to speak. Many had been the attempts to maintain a journal which would adequately represent the electrical arts and sciences in this country prior to 1882, but failure had followed every effort. It is not too much to say that to Franklin Leonard Pope is due the credit as well as the honor, of having placed electrical journalism in America on a level commensurate with its importance, and representative of the industries and the science which it was its mission to foster and represent. As the former editor of this journal and as a contributor to its columns up to the time of his death, Mr. Pope ever displayed that acumen which characterizes the true journalist accompanied by fairness of treatment of all topics, independent of personal feelings. In the death of Mr. Pope the electrical profession loses one of its brightest ornaments, and in common with a host of friends and a bereaved family, we mourn our loss.

FIRST ANNUAL MEETING OF THE OHIO ELECTRIC LIGHT ASSOCIATION.

The Annual Meeting of the Ohio Electric Light Association was held at Piqua, Ohio, October 8th. This was its first annual meeting, the Association having been organized only in May last, and the attendance was most gratifying under the circumstances The Secretary was able to report that the Association now had on its membership roll nearly fifty per cent. of all the central station companies operating in the State. The officers chosen at the preliminary meeting were re-elected for the ensuing year. They are: President, A. W. Field, Columbus Edison Electric Light Co.; vice-president, Wm. C. Hedges, Mansfield Electric Light & Power Co.; Secretary and Treasurer, Samuel Scovil, Cleveland Electric Ill'g. Co. Executive Committee: B. P. Holmes, Youngstown Electric Light Co.; H. K. Wood, Piqua Electric Co.; L. C. Newson, Columbus Electric Light and Power Co.

The Constitution of the Association as originally adopted provided for active, associate and honorary members. At this Piqua meeting the Constitution was amended, so as to confine the membership to two classes, active and honorary members. Under the head of associate members, the original intention was to afford representation in the Association to any manufacturer of electrical apparatus or supplies. Under the Constitution as amended, manufacturing companies cannot now openly obtain representation in the Association.

The following resolution was unanimously adopted:

Whereas, Certain manufacturers of electrical apparatus have in the past, and are at this time attempting to secure franchises for the installation of electric lighting plants in certain cities of this State, and

Whereas, These franchises are not sought for the purpose of making a legitimate investment, inasmuch as the demand for electric service in these towns is not sufficient to support an additional company, but is rather for the purpose of compelling the existing companies to become customers of these manufacturing companies.

Resolved, That this Association now put itself on record as condemning such business methods, as being neither more nor less than blackmail, and that such methods justify the Association in requesting each of its members to refuse to purchase of such companies any apparatus whatsoever, if they thus continue their piratical attacks upon the invested capital which this Association represents.

At the morning session of the Association, October 9th, Mr. Caryl D. Haskins, of the General Electric Co., read a paper on the use of meters and transformers, which was very interesting, and considered so valuable that the Secretary was directed to have it printed and distributed to the members of the Association.

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dack Division of the New York Central Railroad; and the enjoyment of the trip was greatly added to by the stop over, on the return by daylight, up among the Adirondack Lakes, which more than compensated for the delay, the Adirondacks never looking more gloriously beautiful than they do now in the profusion of their Autumn tints. A large party from Philadelphia went over the New York Central on Monday morning. The Delaware & Hudson Railroad hauled a very large number of passengers to and from the convention, with a service so well equipped and a punctuality so marked, that it will certainly receive the further patronage of all who entrusted themselves to it.

"THE BRILL SPECIAL."—In addition to the regular special train, a number of delegates to the Convention were taken in charge by Mr. W. S. Heulings, Jr., who provided special accommodation for them over the New York Central and Delaware and Hudson R. R. The party left New York on the Empire State Express reaching Albany about eleven o'clock, where, after a delightful drive round the city, they dined together, and then proceeded on their way to Montreal in a special car by way of the Delaware and Hudson. They reached the Windsor Hotel on Monday night about ten o'clock after a most enjoyable trip through some of the grandest scenery in this section of the country,—all agreeing in rendering to Mr. Heulings a hearty vote of thanks for his thoughtfulness and care.

THE MONTREAL STREET RAILWAY CO. and the Montreal Park and Island Railway Co. were most attentive and courteous, and thanks are due to Messrs. Lusher, Cunningham, Blackwell, Corriveau, Holgate and other officials. Mr. Watts, who was their righthand man and the connecting link between the local and visiting bodies, was a host in himself and performed prodigies of work. The button of the Association admitted the wearer free on all street railways, while several special trips and excursions were organized. On Saturday the delegates were taken to Ottawa by Mr. Ross and there entertained by him and the Ottawa Railway through Messrs. Ahearn & Soper.

THE ANNUAL DINNER, given at the Windsor, and in the worst Windsor style, was a very tame and wearisome affair, the quality of which may be judged from the fact that a local windbag, who is not and never has been interested in street railways, responded to the important toast of the American Street Railway Association! Speeches were also made by Dr. Newman, the American Consul, Messrs. Hurt and Cunningham, Alderman Ogilvie, and Chief Justice Lacoste, while Mr. Stedman made a bright and most welcome response for the ladies; and Mr. C. W. Price was brief, apt and to the point, in response to the "Technical Press."

MR. FREDERIC NICHOLLS, of the Canadian General Electric Co., and vice-president of the National Electric Light Association gave a dinner party on Wednesday at one of the Clubs, the guests being Messrs. J. A. Seely and C. O. Baker, Jr., of the Association; Dean Bovey, of McGill University; Mr. Frank Redpath; Mr. K. W. Blackwell, director, Montreal St. Ry. Co.; Mr. F. Ross Mackenzie, manager, Niagara Falls Park Road, and Mr. T. C. Martin, editor, THE ELECTRICAL ENGINEER. The occasion was most delightful, as a felicitous reminder of the convention of 1891, and as an opportunity for the renewal of friendships then formed. Mr. Nicholls was happy to receive from Prof. Bovey the promise of his attendance in New York next spring at the convention, and to assure his American guests that Canadian interest in the N. E. L. A. was stronger and warmer than ever.

THE RECEPTION AT MCGILL UNIVERSITY.—The reception at McGill, on Wednesday afternoon, proved quite an enjoyable affair. The guests were received at the Engineering building by Dean Bovey, Prof. Bamford, Prof. Harrington, Prof. Nicholson, Prof. Carus Wilson, Prof. Calander and Mr. W. Carlyle. These gentlemen, with Dean Bovey and Prof. Bamford at their head were assiduous in endeavoring to make the visit a pleasant one to the company. They were shown everything to be seen in the building, and the electrical machinery and testing apparatus were set in motion for their entertainment. Refreshments were provided in one of the upper rooms of the building. No finer exhibit of modern scientific apparatus than the equipment of the Engineering and Physics Buildings at McGill can be found on this continent; we doubt whether any in Europe excels it. The museum in the Engineering Building includes for example the original Reuleaux kinematic models. The mere intrinsic value of the apparatus is over $1,000,000, gathered largely through the efforts of Dean Bovey, who has thus done nobly for science and engineering in the Dominion.

ANOTHER GOOD THING.

"Please send me a filing case (morocco) for Data Sheets. I have been a subscriber since Jan. 1890, and although every number is full of good things, the Sheets are the most practical, instructive articles I have seen since the above date. Wishing you success." F. C. Hard, Woburn, Mass.

EXHIBIT NOTES.

MR. J. D. MILLER represented the Pierce & Miller Engineering Co., of New York.

THE VACUUM OIL CO., of Rochester, were represented by Mr. E. A. Record, who has a large clientage among railroad men.

THE KEASBEY & MATTISON CO., of Ambler, Pa., manufacturers of pipe covering, were represented by Mr. Wm. Sclater.

MR. ELMER A. SPERRY, of Cleveland, was present to represent his electric railway and electric brake interests.

JACKSON & SHARPE CO., of Wilmington, were well looked after by Mr. E. C. Jackson and C. E. Pratt.

THE WASHBURN & MOEN MFG. CO., of Worcester, Mass., were represented by Mr. F. A. Keyes.

THE HEINE SAFETY BOILERS' merits were dilated upon by Mr. E. D. Meier, who had new "bonus" checks to show.

THE SIEMENS & HALSKE CO., of Chicago, entrusted their interests to the care of Mr. H. E. T. Pringle.

THE ROCHESTER CAR WHEEL WORKS, of Rochester, N. Y., were represented by Mr. F. D. Russell, and a fine foot rule.

THE WASON CAR MFG. CO. were represented by Mr. L. C. Hyde.

HOLMES, BOOTH & HAYDENS' interests were in the hands of Mr. T. A. Hurley and L. A. Milbafik.

THE BEMIS CAR BOX CO., of Springfield, Mass., were represented by Mr. G. M. Hoadley, who was glad to talk trucks with anyone interested.

THE FULTON TRUCK & FOUNDRY CO., of Cleveland, manufacturers of trucks for electric cars and other railroad specialties, had Mr. W. G. Haycox on the ground to look after their interests.

THE OHIO BRASS CO., of Mansfield, O., had a very handsome exhibit of their specialties in trolley line construction, and all kinds of overhead material, used for street railway purposes.

MR. L. G. LILLEY, Inspector of the Underwriters' Association, of Cincinnati, was present at the Convention, and renewed his friendship with many of the delegates to the Convention.

THE PHŒNIX CARBON CO., of St. Louis, were represented by H. McL. Harding, who has the eastern agency for their products.

THE PENNSYLVANIA STEEL CO., of Steelton, Pa., had an exhibition of their various designs in steel rails, &c., for street railway purposes.

THE AMERICAN RAIL JOINT CO., of Cleveland, had an interesting exhibit of their method of making joints on street car rails which attracted wide attention.

THE TAYLOR ELECTRIC TRUCK CO., of Troy, N. Y., had an interesting exhibit of their truck equipped with a life saving device which appeared to act very successfully.

THE ELECTRIC STORAGE BATTERY CO., of Philadelphia, who now control so many patents in storage battery practice both for central station and traction purposes were represented by Mr. A. W. Childs, of Boston.

THE FUEL ECONOMIZER CO., of Matteawan, N. Y., were represented by Mr. Wm. Downs, S. Greene and W. E. Gomer who were able to show great economy in heating feed water by using the Greene system.

THE JOHNSON CO., of Johnstown, Pa., were represented by Messrs. H. C. Evans, E. O. Evans and O. C. Evans all of New York, who succeeded in making their company even more popular than before with the delegates.

MR. GEORGE S. WHYTE, of Chicago, was present to do the honors of the occasion for the Badger Manufacturing Co., of Milwaukee, Wis., manufacturers of overhead material, and the Chicago Insulated Wire Co., manufacturers of all kinds of insulated wires and cables.

THE CANADIAN GENERAL ELECTRIC CO. made no exhibit, but was adequately represented by Mr. Frederic Nicholls, whose headquarters were, of course, his branch offices in Montreal. The company has the lion's share—and the eagle's, too—of all Canadian electrical business.

THE PARTRIDGE CARBON CO., of Sandusky, Ohio, was represented by Mr. J. S. Speer. Mr. Speer made no exhibit, but had a few samples of carbon brushes for street railway motors and generators in his pockets, and stated to a few of his friends at the Convention that their carbons had been almost universally adopted among railways within the past year or two. There is hardly a railroad in the country that does not use the Partridge Carbon.

The American Mica Co., of Boston, were represented by Mr. E. P. Sharp, of Buffalo, who showed a few samples of their well known specialties.

The Meaker Mfg. Co., of North Chicago, showed a line of car fare registers, trolley hanger and mechanical clip, and were represented by Mr. J. W. Meaker.

Charles Scott Spring Co., of Philadelphia, were represented by Mr. Charles Scott, Jr., H. C. Johnson, and W. H. Hansell. They showed samples of their elliptical and spiral springs for street car purposes.

The Goubert Manufacturing Co., of New York, were well represented by Mr. W. T. Bonner who showed a few models of the Goubert type of feed water heater largely used in street railway power houses.

E. P. Sharp, of Buffalo, N. Y., was in attendance, representing a number of railroad specialties, manufactured in the United States, in addition to his regular business of second hand electrical apparatus.

The R. D. Nuttall Co., of Alleghany, Pa., were represented by Messrs. F. A. Estep, C. J. Mayer, C. N. Wood and E. P. Sharp, who showed some samples of their trolleys, gears and other specialties suitable for street railway car equipments.

The Beacon Lamp Co., of Boston, were represented by Mr. E. P. Sharp of Buffalo, who showed up the many excellent qualities of the Beacon railway lamps, which are in use on many street railways.

The Babcock & Wilcox Co., of New York, were represented by Mr. Wm. T. Bonner, manager of the Canadian department. They showed samples of all the steel forgings used in the construction of their latest type of boiler, and also a few photographs of large stations using this popular type.

The Western Electric Co., of New York and Chicago, were represented by Mr. J. Wiley, who had no exhibit but showed a few samples of their general street railway supplies, which are extensively used by many Companies in the United States and Canada.

The Canada Iron Furnace Co., of Montreal, showed a case containing samples of the different ores and grades of iron manufactured at their plant at Radnor Forges. This company manufacture the famous grade of iron known as C. I. F. Three Rivers, charcoal pig iron.

The Standard Air Brake Co. were represented by Mr. E. J. Wessels, the general manager, whose excellent paper will be found elsewhere in this issue. Mr. Wessels has done more than any other man to educate intelligent opinion on brake betterment, and his work has made a profound and lasting impression for good.

The H. B. Camp Co., of Aultman, O., were represented by Mr. A. L. Daniels, of Akron, and showed samples of their underground vitrified clay conduit, which is laid in the ditch like ordinary brick work, each piece being about 18" long, and having one duct 3¼" clear. It is simple, strong, permanent, highly insulated and has been laid in almost every city in the States.

The Crane Co., of Chicago, Ill., showed a full line of their well known wedge gate, globe, angle, check and pop safety valves suitable for high pressure steam work in electric railway stations. They also showed a novelty in the shape of an indicator stand, telling how much a valve is open, both by inches and square area. They were represented by Mr. G. A. Hurd.

The Skeen Electric Switch and Signal Co. of St. Louis, Mo., represented by Mr. R. S. Skeen and H. O. Rockwell, had a very interesting exhibit of their novel automatic semaphore signal for signalling cars when approaching crossings, and for turn outs on single track roads. The signal is automatic in its action and is operated by the trolley on the car by means of a special contact inserted in the trolley wire.

C. C. Sibley & Co.—A decidedly novel and useful system was exhibited by C. C. Sibley & Co., of New York, in the Barnard Selector and Telephone-Signal System. This is an extremely simple plan of providing telephonic communication between all the important points, together with the ability to set at the called station a permanent signal such as a lamp, semaphore or bell, or any two or all three of them to arrest the attention of the next employee that may be passing. Unlike the ordinary telephone systems, no central station or operator is required, and but two wires are necessary, no matter how many stations are connected. Further, these two wires afford a complete metallic talking circuit, so that the street railway poles are used without incurring any disagreeable induction. On electric roads where the trolley wire affords a source of supply, the railroad current is used for the signals and a battery current is only employed for the talking circuit. As, however, these instruments only require three watts each, this system may be employed on cable or steam roads and operated by battery current.

The National Conduit Co., of New York, were represented by Mr. J. P. McQuaide, of New York, who had no exhibit with him, but who, from his extensive acquaintance amongst street railway men, met many interested in discussing the best method of laying their feeders underground. This company has laid so much underground work in the past few years that there is little difficulty in convincing railway men of the excellence of their system.

The Consolidated Car Heating Co. were represented by Mr. J. F. McElroy, H. N. Ransom, and W. P. Cosper and showed samples of their various styles of electric heaters, separate and installed under seats, in the usual manner adopted for street car purposes. The heaters were shown in operation and helped materially in decreasing the unpleasantly cold temperature of the hall. They also showed a temperature regulating switch, by which the heat in a car is controlled by their five point switch.

The Pettingell Andrews Co. of Boston, were represented by Mr. C. B. Price and Mr. F. X. Cicott, who showed a few samples of their well known drop forged overhead material recently placed on the market. These goods are manufactured by the Billings & Spencer Co. of Hartford, Ct., and the Pettingell Andrews Co. are the sole selling agents for United States and Canada. They also distributed very handsome souvenir catalogues, which should be in the possession of all interested in street railway construction.

T. Euphrat, of Darien, Conn., was represented by Mr. C. C. Perry, who showed samples of his trolley wheel harp and ice cutter. The cutting wheel is made in two separate sections, and is so constructed that while it removes the ice, it will not damage the overhead wire. Mr. Perry also showed their combination housing frame trolley wheel and ice cutter, the housing frame lying stationary and furnishing the same spread as the present standard trolley wheels, making the renewal of the trolley wheel a much lighter item of expense to the railway company.

The Standard Paint Co., of New York, were represented by Mr. F. S. De Ronde, general sales agent of the company and Mr. J. C. Shainwald, manager of the Chicago office. They had a very attractive exhibit occupying a prominent position, composed of samples of their well known street railway specialties, such as P. & B. tape, motor cloth, and armature varnish and the only P. & B. compound, whose reputation for quality is now known in almost every civilized land. In addition Mr. De Ronde distributed a large number of his excellent P. & B. cigars, the peculiar brand being sufficient guarantee of good quality to all smokers.

The Cutter Electric Manufacturing Co., of Philadelphia were represented by Mr. W. E. Harrington, and showed a few handsome samples of their perfected automatic magnetic circuit breakers, particularly drawing attention to the double pole type, twenty of which are to be used for the Library of Congress Building switchboard in Washington. They also showed samples of the Standard switchboard, and the circuit breaker as specially adapted for street cars. These circuit breakers attracted wide attention among the railway men, as an article of particular virtue doing away with the necessity for the oldtime fuses.

The Standard Underground Cable Company, of Pittsburgh, New York and Chicago was represented by Geo. L. Wiley, of New York. A general line of electric wires and cables was shown in the Company's exhibit at the Victoria Rink. The special features were the very handsome underground feeder cable samples from 1,000,000 circular mils down. These samples were cut from cables in use by prominent street railway companies in Boston, Philadelphia, Chicago and Buffalo, and the name of the railway company and the quantity of cable purchased was indicated on tags attached. The cables represented were made and installed by the Standard Company.

The Walker Mfg. Co. had what must be considered the best exhibit on the floor, and were represented by Messrs. H. McL. Harding, R. N. Baylis, while Mr. C. W. Kent was in special charge of the apparatus shown. The space, about 1,100 square feet, was fenced in with handsome newel posts capped with 5 light standards, and encircled with heavy rope of the kind used on hauling drums, etc. The exhibit consisted of two complete trucks. The Dorn & Dutton was equipped with two 25 H. P. Walker motors, standard make; the Peckham truck was equipped with two 50 H. P. of the type used in interurban work. Speeds run up to 35 and 40 miles an hour with these, on such roads as the Rapid, between Detroit and Mt. Clemens, and the Waukesha, Wis. The controller was also on exhibition connected up to run one of the trucks, so that the whole system could be seen in actual operation. A very handsome standard board was shown of two machine, with double feeder panels; capacity of the machine-panels being 200 K. W. each. A motor was opened up also to show the inside arrangements and an armature partially wound to exemplify the method of winding, and the disposition of the coils. All this was supplemented by a large collection of field coils, fuse boxes, etc., and a number of pictures illustrative of Walker work.

THE AKRON INSULATOR AND MARBLE CO., of Akron, O., showed a full line of the "Standard" tubing made of vitrified clay for insulating purposes, and were represented by Mr. A. L. Daniels.

SCARRITT FURNITURE CO., of St. Louis, showed samples of steam and street car seating, and were represented by Mr. S. G. Scarritt.

THE STIRLING CO., of Chicago, were represented by Mr. F. A. Scheffler of New York, who had an exhibit of their well known boilers in charge of Messrs. Darling Brothers, of Montreal, who represent them in Canada.

BAKER & CO., of Newark, N. J., were represented by Mr. C. O. Baker, Jr., who met many old friends in the street railway business, and made many new ones by his uniformly courteous bearing. He made a special study of the Association methods of transportation for future use.

BELDEN & SEELY were represented by Mr. John A. Seely, who as one of the largest lighting and railway contractors found much to interest him in the convention. The firm have a number of contracts on hand, and just now are making a further large extension of the railway system in Syracuse.

THE HALE & KILBURN MFG. CO., of Philadelphia, Pa., were represented by Mr. C. E. Barrett, of Philadelphia, and Mr. H. T. Bigelow of Chicago. They showed samples of their "Walkover" street car seat, in use on many street car systems. The feature of the seat is that the back walks over the seat instead of reversing, when changing the direction of the car.

GRAHAM EQUIPMENT CO., of Boston, were represented by Mr. J. H. Graham, and showed a steel frame car entirely spring suspended and equipped with Graham's equalized brakes. The claims made for this car are that it is cheap, weighs one-half of a regular car and the floor of the car is eight inches nearer the ground than other cars.

BENEDICT & BURNHAM MFG. CO., of Waterbury, Conn., were represented by Mr. J. H. Woodward, of Waterbury, and Mr. E. L. Rugg, of Boston. They showed a full line of samples of the solid one piece rail bond, and feeder, trolley and magnet wires. The rail bonds are used extensively by railway companies in many cities and are giving great satisfaction.

THE CHAPMAN VALVE MFG. CO., of Indian Orchard, Mass., showed samples of the Chapman valves specially adapted for power house work, and had the pleasure of referring to their larger and more important exhibit in the power house of the Montreal Street Ry. Co. and the testing department of the McGill University, both of which are equipped throughout with Chapman valves. Mr. Ross was as usual in full charge.

THE FALK MANUFACTURING CO., of Milwaukee, Wis., were represented by Mr. E. A. Wurster and Albert Hoffman, Supt., and showed samples of their cast-welded rail joint. The rails are laid as usual and the metal cast round the joint in position, making a perfectly homogeneous joint, and doing away with the necessity for fish plates, bond wires, and bringing the cost of maintenance of track down to a minimum.

THE NEW YORK CAR WHEEL WORKS, of Buffalo, N. Y., the ST. THOMAS CAR WHEEL CO, of St. Thomas, Ont., and the MONTREAL CAR WHEEL CO., of Montreal, were represented by Messrs. A. E. Domville, of St. Thomas, and T. J. Drummond, of Montreal. They showed samples of machined wheels and axles for motor cars and trailers. The wheels shown were of various weights and handsomely finished, and showed up to great advantage.

MR E. W. LITTLE, general manager of the Interior Conduit and Insulation Co., found the convention an excellent opportunity for meeting and conferring with several of their agents, from all parts of the United States and the Dominion. The Company are now introducing a greatly improved underground distribution system for railway work, for which there is evidently a large field, and with regard to which he was able to furnish information to a number of inquiring street railway managers.

THE ABENDROTH & ROOT BOILER CO. were represented, as usual, by Mr. P. M. McLaren, who had no exhibit, but circulated around among his many friends so as to keep in touch with the trade and to point out the peculiar merits of the boiler which he so ably represents. From his long and practical experience, Mr. McLaren seems to know every one worth knowing amongst the street railway men from all parts of the country, and appears to have the good points of boiler construction down to a fine system.

THE FIBERITE CO., of Mechanicville, N. Y., were represented by Mr. H. J. Medbery and Mr. W. R. Mason. They showed a most complete assortment of trolley hangers, curve brackets, strain insulators, frogs, cross-overs, circuit breakers, trolley wheels and harps, as well as station switches and waterproof sockets. One of the most interesting features of the exhibit was the fact that they were able to refer to the Montreal Street Railway Co. and the Montreal & Park Island Ry., whose lines are all equipped with the Medbery insulation.

THE FOREST CITY ELECTRICAL WORKS, of Cleveland, O., were represented by Mr. W. B. Cleveland, of Cleveland and J. C. Dolph of New York, who had an interesting exhibit of rolled-drop commutator bars, which are all put through the cold process of forging. It is claimed that this process makes a much tougher bar, and they are being used for street railway work.

THE OKONITE CO., of New York, were represented as usual by Captain Willard L. Candee, who showed samples of the favorite Manson tape, put up in attractive little packages for distribution. This tape is a favorite with street railway companies, and is much used by them in addition to the regular consumption of Okonite wires. They also showed a few samples of heavy Okonite wires and cables for street railway purposes and some handsome samples of heavy submarine cables.

CHARLES A. SCHIEREN & CO. were represented as in past years by Mr. Charles A. Schieren, Jr., who, while he did not have any regular exhibit, showed a few samples of their well-known perforated electric leather belting, and distributed to his many friends a little souvenir of the occasion in the shape of a belted match safe. The Schieren belts have found favor in many foreign countries no less than at home; and many manufacturing companies in far-away countries are willing to pay not only the freight but duty also to have belts of American manufacture.

THE NEW HAVEN CAR REGISTER CO. of New Haven, Ct., were represented by Messrs. J. S. Bradley, F. C. Boyd, F. A. Morell and A. N. Loper. They showed samples of their single, double and triple fare registers finished in nickel, antique copper and bronze, the double and triple registers being entirely new in the market, very simple in operation, and recording two or three different denominations of fares or transfers, and being operated by one rod. They also showed a full line of rod and cord fixtures and ringing devices for registers and a universal extension bracket, a novelty of considerable importance.

HABIRSHAW WIRES were represented by Mr. J. W. Godfrey and F. W. Harrington, who exhibited samples of the bus bars used by the Cataract Construction Co., of Niagara Falls, N. Y., which have given the greatest satisfaction, and show great skill on the part of Mr. W. M. Habirshaw in meeting the severe requirements of that company. These bus bars are composed of heavy copper tubes, insulated under the Habirshaw patents, to withstand a pressure of 20,000 volts. In addition they showed some handsome samples of underground cables for high pressure, and other samples of their regular lines of goods. Mr. Godfrey had great pleasure also in showing a remarkable photograph of their Japan representative, which elicited wide attention as evidence of the wonderful advances made in Oriental photography. Copies of this photograph will *not* be mailed on application.

THE AMERICAN ELECTRICAL WORKS, of Providence, R. I, were represented by Messrs. W. A. Hathaway, P. C. Ackerman and F. E. Donohoe; and by Mr. John Carroll of the Phillips Insulated Wire Co. of Montreal. They showed samples of the American Rail Bond, and distributed a number of circulars showing the bond in section and explaining its details. The bond is made either flexible or solid, and is inserted into a bushing which fits tightly on the bond. This bushing does not fill the hole in the rail, however, and another bushing is driven in from the other side completely filling the hole and compressing the inside bushing and bond, after which both ends are upset and a thorough contact and durable joint is thus made. In addition they showed samples of their feeder cables, trolley wires and magnet wires, all applicable to street railway purposes, and which are largely used amongst the railway companies.

HOGAN BOILER CO. were represented by Mr. J. J. Hogan, who had an interesting exhibit of their products. They showed a mechanical steam extractor, for the prevention of any water passing from the boiler with the steam. Several railroad men expressed the opinion that it did not seem possible for water to pass this extractor. Extension sleeves were shown, these sleeves being used on the end of the tubes and protruding into the steam drum above the water line. By this means the effect of ebullition on the water surface is destroyed and a perfectly steady water line is produced, thus preventing all danger of foaming and priming. A feed water inductor was shown by means of which the feed water is raised almost instantaneously to the temperature of the water in the boiler, without injury to any part, producing precipitation of all foreign matter and depositing it in the lower drum not exposed to the heat, thus preventing scale on the heating surfaces. A mud drum was exhibited with high pressure joints, metal to metal, tested to 850 pounds, and also the steel ends for the distributing drums with manholes and covers, the joints being made with copper gaskets—also contrived in such a manner that pressure increases their tightness. These gaskets do not need to be renewed when the manhole is opened. They also showed samples of the cold bent charcoal iron tubes of a special thickness, built by special machinery, used in the construction of the boiler, and tested to 500 pounds pressure after being bent. Numerous photographs of various boilers installed in electric light and railway plants were also shown, and were closely inspected by the street railway men present.

WARREN WEBSTER & CO., of Camden, N. J., were also represented by Messrs. Darling Bros. who showed a sample of the Webster Vacuum Feed Water Heater of 150 horse power.

C. S. KNOWLES, of Boston, was represented by Mr. J. H. Parker of Boston, who had no exhibit but was pleased to meet and talk with many of his friends in the railway business, on the subject of insulation.

OSCAR L. WHITNEY of Cambridge, Mass., showed a model of the Whitney automatic car fender and wheel guard attachment, which can be attached to any flat fender and which makes it impossible for any object on the tracks to get under the wheels.

EUGENE MUNSELL & CO. exhibited mica in its rough state, as it comes from the mines, also samples of mica cut to size, and samples of mica cut for commutator segments for the various railway commutators. They also showed a few rare specimens of India sheet mica, one of the company's strong specialties.

A. WHITNEY & SONS of Philadelphia, were represented by Mr. F. A. Lex, of Philadelphia, who had no exhibit, but talked with his numerous friends in the street railway business on the necessity of equipping their cars with reliable wheels. Messrs. Whitney have at present some very large contracts on hand, and are running some of their departments day and night.

THE MCPHERSON SAND BOX CO. of Troy, N. Y., were represented by Mr. Henry McPherson and Mr. J. F. Hart, who showed a sample of their sand box, which is the only box which pours the sand from the top of the box, and being revolved when put in operation, keeps the sand constantly agitated; hence requires no sifting, and is always absolutely sure of pouring.

THE H. W. JOHNS MFG. CO., of New York, were represented by Mr. E. B. Hatch, of Hartford, H. G. Issertel, of New York, and J. W. Perry, of Philadelphia. They showed some samples of the well-known Johns' moulded mica overhead line material, which is now so well known among railroad men as to require no special description at this time.

THE WESTINGHOUSE REPRESENTATIVES were not located at the Windsor. They had headquarters at the Queens, and in parlor 218 at that hotel some one of the many Westinghouse men was always found to extend the hospitality of his company. As usual the number of representatives of the Pittsburg company was large, in keeping with the importance of the concern. The following are the names of the Westinghouse men, who were found registered: G. H. Lewars, Asst. Treasurer; Albert Schmid, Genl. Supt.; E. N. Sanderson, J. H. Rutherford, C. A. Bragg, B. F. Stewart, R. S. Brown, H. E. Craigin, E. F. Gordon, E. H. Heinrichs. With this array of energetic workers to reckon with, the convention had no chance of forgetting the name of Westinghouse; and that the delegates were kept fully informed as to the superiority and excellence of Westinghouse motors and generators goes without saying.

THE GENERAL ELECTRIC CO.—The exhibit of the General Electric Co. was made in one of the stores of the Windsor Hotel. In the centre of the large room stood a Peckham truck, equipped with two G. E. 800 motors, and upon each axle was one of the Sperry electric brakes. Current was brought to the motors from the lines of the Montreal Street Railway and the brake was shown in operation. Down one side of the room was shown the trio of General Electric motors, the G. E. 800, the G. E. 1,200 and the G. E. 2,000. The other side of the room was occupied by a table upon which was displayed a full line of overhead appliances. Dividing the exhibit from the reception parlor, where delegates found the usual solid—and liquid—welcome, was a fine example of switch-board work. This consisted of a switch-board built up with General Electric panels for generators and feeders. The extreme left was occupied by one of the large 5,000 ampere generator panels constructed for the West End Road of Boston. Above the motors and appliances were hung a set of Thomson arc lamps for railway circuits. The controllers shown were the familiar K2 and that used in the operation of the Nantasket Beach Road—a massive and effective looking piece of apparatus. The miniature lamp department of the Company was represented by two revolving devices in the windows, and a crescent moon hanging from the centre of the ceiling over the exhibit, with a little witch, broom and all, sitting in the horn. A large illuminated sign over the doorway told visitors where the General Electric Company's representatives could be found, and innumerable incandescent lamps served to light the room and give it an air of warmth which was sadly lacking at the rink.

The representatives were as follows: Messrs. F. M. Kimball, P. L. Saltonstall, C. C. Pearce, P. Hodges, of Boston; W. B. Potter, L. Dunbar Tandy, A. S. Heywood, of Schenectady; R. H. Beach, A. K. Baylor, W. G. Bushnell, Elmer P. Morris, of New York; H. J. Crowley, of Philadelphia; S. W. Trawick, of Atlanta; F. H. Strieby, of Cincinnati; F. C. Todd, of Baltimore; T. H. Fearey, of Buffalo; G. D. Rosenthal, St. Louis, represented the factory and the district offices East of the Mississippi. Much regret was expressed at Mr. W. J. Clark's absence, as people have come to consider no convention complete without him.

ELECTRICAL ENGINEERS.—There was a large contingent of electrical engineers at the meeting, from various parts of the country. Among them may be named Messrs. C. J. Field, W. J. Hammer, J. L. Woodbridge, W. Turner, F. R. Ford, T. W. R. Meiklebam, F. E. Kinsman, A. L. Johnston, C. E.

MR. WM. S. HEULINGS, JR., of Brill fame, was presented on Friday evening on the train returning to New York, in the midst of a few select friends, an interesting souvenir of the occasion, in the form of a small silver "skate" made in the form of a breast pin. The souvenir was presented by Messrs. Rigg and Allison, who were a committee of two to represent Mr. Heuling's numerous friends and admirers.

THE JEWELL BELTING CO., of Hartford, Conn., were represented by Mr. C. L. Tolles, who exhibited samples of their new pulley covering, which is now being largely adopted in central stations on account of its excellent qualities, the adhesiveness of the belt being greatly increased by its use, and a large percentage of the useless slip eliminated. Mr. Tolles also showed a few samples of the standard Jewell belt, which has been adopted by many railway companies, and in addition had as usual a few useful souvenir pocket books for his particular friends.

THE DITTRICK FENDER was shown on the Walker car truck by Mr. Dittrick, of Cleveland, and attracted favorable comment, from the fact that it does not project beyond the platform sill and that its release cuts off the supply of current to the motors. A practical demonstration of its efficiency was given by one of the Montreal street cars in front of the hotel, when in the presence of hundreds of spectators, a man who played the part of a presumable trolley victim allowed himself to be picked up from the track by a car running full tilt. It was a most spectacular and brilliant demonstration, and literally "brought down the hotel," encores being vociferously called for and given by Mr. Dittrick and his star performer.

J. G. BRILL CO., of Philadelphia, were represented by Messrs. J. A. Brill, vice-president; F. C. Randall, S. M. Curwen, G. M. Haskell, M. E Curwen, W. H. Heulings, Jr. They had a parlor on the ground floor of the Windsor Hotel, and entertained their guests in their usual magnificent and cordial manner. On two tables they showed three handsome models of trucks, No. 1 being the new design for the Lake street elevated railroad in Chicago, No. 2 being the Brill celebrated No. 21 C truck for four wheel cars, and No. 3 being the "Eureka" maximum traction pivotal track. The room was constantly full, and the delegates appeared to find genuine interest in that which is, after all, the heart of the industry—the car and its truck.

MICA INSULATOR CO., of New York, were represented by Mr. C. E. Coleman, and showed samples of Micanite in its various forms for electrical insulation, consisting of micanite plates, cloth and paper; commutator rings, segments and slot troughs or insulations for all the standard types of railway motors. Micanite was also shown in field spools, cylinder heads, tubes and rheostat linings, and the whole made an exhibit that attracted wide attention for its neat arrangement in addition to the interest in the material shown. The large commutator for a power genertor, and the W. P. 50 railway armature were particularly interesting, being insulated throughout with micanite and ready to receive the copper wires or bars. Back of the exhibit was a large transparency with mica front of the company's trademark illuminated by incandescent lamps.

MR. JAMES REAGAN was present to represent the Water Circulating Grate Co., of Filbert street, Philadelphia. The feature of this interesting advance in grate or furnace construction is that it keeps the fire at the desired thickness, at all times permitting a sufficient quantity of air to come in contact with the burning coal. Each set of shakers is separated by a tube through which either the feed or water from the boiler is passing constantly, and these tubes perform a variety of most helpful functions both in protecting the grate, freeing the boiler from scale and in running up the fuel economy. President Radel, of the Bridgeport Traction Co., reports that his road made a saving of 1,288 gross tons of coal in six months, or $4,057, through the use of Mr. Reagan's admirable invention. In other words, the quantity was just about cut in two.

LOMBARD HYDRAULIC BRAKE CO., of Boston, were represented by Mr. H. M. Daggett, Jr., of Boston, who had car No. 424 equipped with their brake, in regular service on the Windsor and St. Lawrence line, handled by the regular motormen of the Montreal Company. The grades on this route are very severe, reaching in one place 11 per cent., and the brake handled the car perfectly and gave great satisfaction. The brake embodies a new principle never before applied to brake work, but which has been applied with great success to water wheel governors—examples of which may be seen at Baltic, Ct., and Niagara Falls. It depends on compressed air for its power, but unlike other brakes, the direct medium of transmitting the power is a non-freezing oil, which passes from the pressure cylinder to the brake piston. After setting the brake, it is discharged into a vacuum and then pumped back into the pressure cylinder by means of a pump driven from the axle.

McPherson Sand Box Co., of Troy, showed a sample of their sand box in operation.

Smeets Bronze Sand and Salt Box, made in Springfield, was shown by model in the exhibition hall.

The Carter Brake Co. were represented by Mr. G. M. Carter of Chicago, who showed the brake in operation.

The Albert Edwards Car Fender Co. were represented by Mr. Albert Edwards of Brooklyn, who had much to say on the merits of his device.

E. F. DeWitt, of Lansingburgh, Ky., was very much in evidence as usual, with his sandbox, which he claims to be the proper device for street railway men to adopt.

The Phillips Insulated Wire Co. were represented Mr. H. C. Adams, Jr., of New York, who had a few samples of their wires and cables with him.

The Berlin Iron Bridge Co., of East Berlin, Conn., were represented by Mr. Albert Bernstein, who had a fund of information to impart regarding the use of iron work in central stations.

The McGuire Mfg. Co., of Chicago, were represented by Mr. W. F. Cooke, who had an interesting exhibit of their various specialties in trucks for street railway purposes.

The Robinson Radial Car Truck Co., of Boston, were represented by Mr. Wm. Robinson, the inventor of the truck and manager of the Company, who had with him a neat little model of his well-known truck, operating on a track.

Morris Tasker & Co. were represented by Mr. H. C. Vansant and C. T. Flanders, of Philadelphia, who had hung in prominent places a few handsome pictures representing their pole devices for street railway work.

John A Roebling's Co., of Trenton, N. J., represented by Messrs. Cockey & Bailey, had a tastefully arranged exhibit, and showed samples of wires, cables, feeder, and all their well-known manufactures, for overhead and underground construction.

Adams & Westlake Co., of Chicago, had an extensive exhibit of their numerous and interesting railway specialties, and their quarters were constantly full of delegates inspecting the handsome samples, and praising their usefulness.

Adam Cook's Sons, of New York was represented by Mr. M. P. Peavey, of Fall River, Mass., who showed in the Exhibition Hall a few samples of their well-known Albany grease for lubricating purposes, which has already become a favorite form of lubrication with street railway men.

Consolidated Car Fender Co., of Providence, was represented by Mr. J. W. Range, who had a full sized car fender on exhibition in the Hall, which was operated constantly by Mr. Range, who deserves a great deal of credit for his courtesy to all curious visitors, as to the method of its working.

The Fitzgerald-Van Dorn Co., of Chicago, was represented by Mr. W. T. Van Dorn, who showed a handsome sample of the Van Dorn Automatic Draw Bar for electric, cable and street railways, which appeared to attract considerable attention among the delegates.

The Sterling Supply and Manufacturing Co., of New York, had one of the largest exhibits in the hall, and had a most desirable central location. They showed samples of nearly every kind of electric specialty used by street railway men, but called particular attention to their well-known car fare registers, which are extensively used on many roads.

President Rhotehamel again attended the Convention as the representative of the Columbia Incandescent Lamp Co., and may be said to be as much at home in the gathering as in that of the N. E. L. A. men. Street railways are not a large market for lamps, but a very generous portion of that branch of the trade finds its way to St. Louis and the Columbia office.

The Chas. F. Burns Co., of Rochester, N. Y., was represented by their president, Mr. C. F. Burns, who made no exhibit, but who had a few samples and circulars of his railway specialties to distribute among his numerous friends. Mr. Burns is popular among railroad men, and had hosts of friends who were glad to meet him on this occasion.

The Safety Insulated Wire and Cable Co., of New York, was represented by Mr. H. T. Richards. They showed a few samples of their well-known wires and cables, although they made no exhibit. The goods of this Company are too well-known to require any large exhibit, as they have been used to a large extent for electric railway feeders, and other purposes, and are well-known to all street railway men.

Canadian Manufacturers mustered in good force among the exhibitors in the Rink. Among them may be mentioned: the St. Lawrence Machinery and Supply Co., Montreal, oils, packing and engine supplies; G. E. Smith, Sherbrooke, patent power rail bender; A. Roy Macdonald, Jr., an interesting booth imitating a mica mine with slabs arranged around it as if just excavated; N. N. Piper & Son, Toronto, electric head and signal lamps; A. W. Glassford, Montreal, brass fittings for cars; Darling Bros., Montreal, vacuum feed water heater; H. R. Ives & Co., Montreal, the Hinphy car fender; Mr. J. J. Burack, Montreal, the "Columbia" car fender made by Lamb & Chapman; J. H. Coleman, Tottenham, Ont., the Coleman automatic car fare box; C. W. Henderson & Co., Montreal, a line of electrical supplies; Canada Switch and Spring Co., Montreal, a standard truck loaded with about 6 tons of rails, but which with the aid of ball bearings took only about 30 pounds of tractive effort to set it in motion. A regular train with these bearings is now in operation on the Grand Trunk.

The Allerton Lubricating Co., of Chicago, was represented by Mr. Chas. J. Seeber, who, while he made no exhibit, was ready to talk on the qualities of high grade lubricating materials, whenever he met any one interested in this subject. The Allerton Co. manufacture every kind of oil and grease used for lubricating purposes, and though a comparatively new Company, have already worked up a large business in this specialty.

The Peckham Motor, Truck & Wheel Co., of New York, had an extensive exhibit of their well-known trucks, and were represented by their president, Mr. E. Peckham. These trucks were shown in various styles and some of them were exhibited with the motors attached in the exhibit of the Walker Mfg. Co., of Cleveland. Mr. Peckham's uniform courtesy to all visitors attracted a large crowd around the exhibit at all times, and won for it many encomiums.

The Electro-Magnetic Traction Co., of Philadelphia, was represented by Mr. J. F. McLaughlin, the inventor of the system, Mr. George Lodge and Mr. John Auchenbole, of England, who represents their interests in that country. Although they made no exhibit of their underground system, they distributed a large amount of interesting literature on the subject, and had throughout a large audience, who were always interested in hearing of the success of their track in Philadelphia. Their system is described in another column of this issue.

Personal.

H. M. LITTELL.

H. M. Littell.

Harvey Mitchell Littell, the newly-elected president of the American Street Railway Association, was born in Corydon, Harrison County, Indiana, in 1856. In early life he moved to Louisville, Ky., and attended the public schools in that city. He embarked in the street railway business as a clerk in the office of the Louisville City Railway company about 1874; the president at that time being C. G. Davidson, now of Brooklyn, N. Y., and H. H. Littell, his brother, superintendent. He filled various positions as clerk in the office, starter, timekeeper, track foreman and almost every position known to the street railway business.

He afterwards entered the steam railroad business with the Louisville and Nash-Railroad company. He worked himself up in the steam railroad business until he reached the position of general freight and passenger agent of what is known now as the Chicago, St. Paul and Kansas City Railroad company. In the interim, however, he filled the position of general manager of the St. Paul City Railway company for a period of three years, from 1883 to 1885, during which time he superintended the reconstruction and extension of the horse railroad system in that city, covering a territory of thirty miles of road. The road then changed hands and he accepted the position of general freight and passenger agent with the Chicago, St. Paul and Kansas City Railroad company.

In 1888, he left the steam railroad business to take charge of the Cincinnati Inclined Plane railway, which road was changed from horse to electricity, under his administration, in the year 1888-1889. He remained there until January, 1893, when he was made president of the New Orleans City and Lake Railroad company and Crescent City Railroad company and general manager

of the New Orleans Traction company at New Orleans, La. These lines embraced about 120 miles of horse railroad, the changing of which to electric lines he superintended, completing the same in June, 1895.

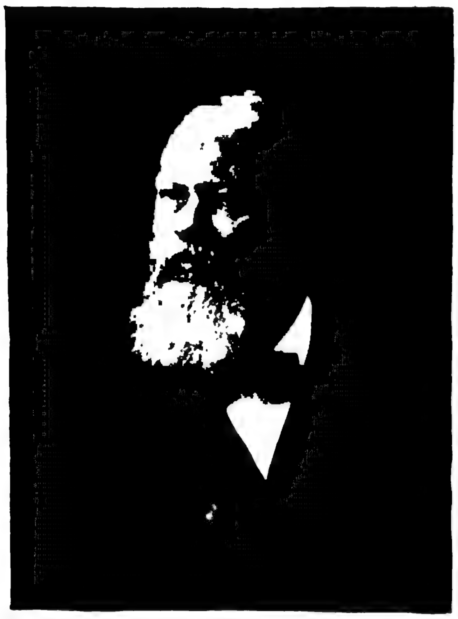
On July 1, 1895, he was made the president and general manager of the Atlantic Avenue Railroad company, of Brooklyn, which position he now holds.

Upon his retirement from the control of the New Orleans roads he was presented by the directors of the company with a solid silver dinner service as a testimonial of their appreciation of his "character and ability as a railroad manager in the development of the property."

Mr. Littell married Miss Prawl, of Lexington, Ky., in 1882. and has two sons. He now resides with his family in Brooklyn,

OBITUARY.

FRANKLIN L. POPE.



Franklin L. Pope.

It is with the deepest regret that we announce the death, by accident, of Franklin Leonard Pope, at his home in Great Barrington, Mass., on Oct. 18th. Mr. Pope met his death by coming in contact with a circuit carrying a potential of 2,000 volts, which fed a pair of converters placed in the cellar of his residence. While the exact manner of his death must, in the absence of witnesses, remain to some extent a matter of conjecture, a thorough investigation of all the circumstances surrounding this most unfortunate occurrence made by Mr. Edward Weston, Mr. William Stanley, and Mr. George A. Hamilton, point to the fact that Mr. Pope met his death through no carelessness of his own. Pending the publication of the detailed report, which is now being drawn up by these gentlemen, we may say that the only marks left by the current on the body of the deceased are on the back of the hand and finger, thus indicating conclusively that the contact was not obtained by grasping any part of the circuit.

The events that led up to the accident were as follows: It seems that a member of Mr. Pope's family in turning on one of the lamps received a shock from the fixture, and upon informing Mr. Pope, the latter, with lamp in hand, descended to the cellar to investigate the trouble which he rightfully laid to a defect in the converter. The wires leading into the cellar passed through a swinging sash, and with a strong wind blowing at the time, it is conjectured that Mr. Pope raised his hand to shield the lamp, and in doing so touched one of the converter cases. As investigation subsequently showed, the primary and secondary of one of the converters were crossed and the line and converter box grounded. The result was that Mr. Pope received a fatal shock.

The funeral which took place on Oct. 16th, was largely attended, many having travelled from long distances to pay their last respects to the memory of the deceased. Mr. Pope leaves a widow, two daughters and a son to mourn their loss.

The eldest of a number of brothers, all of whom have devoted their attention to electrical work, Franklin Leonard Pope was born on December 2d, 1840, at Great Barrington, Mass. His early education was secured at the District School and the Academy of his native town, which was supplemented later by a term at the Academy at Amherst, Mass. From his earliest childhood he displayed great fondness for drawing, scientific and mechanical pursuits, and indeed the first money earned by him was that obtained for a drawing of an engine on the Housatonic Railroad, for which young Pope received the munificent sum of twenty-five cents from the engineer.

The first electrical work undertaken by Mr. Pope followed his appointment as operator at Great Barrington, on the American Telegraph line between that point and Pittsfield, which was opened in 1857, and which position he held for two years, when he was appointed circuit manager of the Boston and Albany Railway wires at Springfield. Finding the field of his operations too limited for his ambition, Mr. Pope determined to seek his fortune in New York, where he readily secured a position as draughtsman in the Patent Bureau of the *Scientific American*, in which position he also had an opportunity of acquiring much useful knowledge of patent law, which stood him in such good stead later on in life. The great demand for telegraph operators created by the war of the Rebellion led Mr. Pope to reënter the telegraph service in 1861. He was stationed at Providence, R. I., where he attracted the attention of Gen'l Marshall Lefferts of the American Telegraph Co., who later on commissioned him to make a complete, detailed report on the Company's lines covering thousands of miles from Maine to Virginia, a work which occupied Mr. Pope's attention for nearly two years; and the result of which led to the standardizing of the Company's apparatus. At that period the Atlantic cable had not yet been successfully operated, and in order to obtain communication with Europe a line was projected by the Russo-American Telegraph Company to make connection between the Eastern and Western Hemisphere via Behring Strait, passing up through the coast from California to Alaska, a distance of nearly 2,000 miles. Mr. Pope was the chief of one of the exploring and locating parties, the story of whose work and hardships would alone fill an interesting volume. Mr. George Kennan, the Siberian traveler, was one of his associates.

The completion of the Atlantic cable in 1866 naturally caused the abandonment of this enterprise and Mr. Pope returned to his home. Upon his return Mr. Pope devoted himself to journalistic work for a short while as editor of the *Telegrapher*, but soon abandoned it to take up the construction of printing telegraph and private line instruments, his inventions finally passing into the hands of the Gold & Stock Telegraph Co., of New York.

Electric railway signalling apparatus next claimed Mr. Pope's attention, and to him some of the fundamental ideas embodied in modern railway signalling apparatus are due. Patents and patent law had always proved fascinating to Mr. Pope, and by his various previous work he had kept in close touch with the subject, so that in the law suits which arose in connection with the printing telegraph system he was able to render valuable assistance in the sustaining of the patents belonging to the Gold & Stock Telegraph Co. This led in 1875, to his being placed in charge of the patent interests of the Company, and later on of those of the Western Union Telegraph Co.

The advent of the electric light naturally attracted Mr. Pope's attention, and in order to devote himself to this growing field, he established the firm of Pope, Edgecomb & Terry, of which he was the senior member. Through his hands some of the most important electrical patent work of this country has passed. When in 1885 Mr. Westinghouse was contemplating the introduction of the alternating system he commissioned Mr. Pope to investigate and report upon the same, and it is largely through a favorable report given by Mr. Pope of this system that Mr. Westinghouse took up the exploitation of the alternating system which has obtained such enormous dimensions in the United States.

It was before this time that Mr. Pope, recognizing the growing importance of electrical work, foresaw the opportunities opened to a journal devoted to the electrical sciences and industry, and to gratify also an inborn taste for journalism and literary work, Mr. Pope aided in the publication of the *Electrician*, issued in 1882, the title of which a few years afterwards was changed to that of THE ELECTRICAL ENGINEER. Mr. Pope acted as editor-in-chief of this journal until its taking over by the present management in 1890. Though he did not have active part of late in its editorial work, its pages have frequently contained articles from his pen. Mr. Pope was the author of a number of works, perhaps the best known of which is his "Modern Practice of the Electric Telegraph," which was published in the early seventies, has passed through many editions with recent revisions made by the author, and still remains a standard work on the subject. Mr. Pope also contributed to the *Century* and other magazines, and of late with great impartiality had edited the department reviewing current electrical events in the *Engineering Magazine*.

During his career Mr. Pope held many positions of honor and trust, among them being the presidency of the American Institute of Electrical Engineers, to which he was elected its second president in 1886, in succession to Dr. Norvin Green.

The latest professional work undertaken by Mr. Pope was the reorganization of the Great Barrington Electric Light Co., a work which was most graphically and minutely described in the paper presented by Mr. Pope before the last meeting of the Institute at Niagara Falls. That paper is in many ways a model of its kind.

Those who were privileged to know Mr. Pope personally will regret the untimely ending of one of such great ability, accompanied by notable amiability of character and modesty.

GEN. SAMUEL A. DUNCAN.

Gen. Samuel A. Duncan, a well-known lawyer of this city, died suddenly from heart disease at his home in Englewood, N. J., on Oct. 18. He was one of the best-known lawyers in this city and was largely engaged in electrical patent-law cases. He was fifty-seven years old, and was educated at Dartmouth College, where he became a professor after being graduated. On the

outbreak of the civil war in 1861, he went to Washington and enlisted in the Union army, in which he rose to the rank of Brigadier-General. At the close of the war he practised law in Washington for a time, and then came to this city.

J. W. MACKAY, JR.

We record with deep regret the death of John W. Mackay, Jr., eldest son of J. W. Mackay, of the Commercial Cable Co. He was at his country seat in France, when he was thrown from his horse against the butt of a tree and never regained full consciousness. He was born in 1870 at San Francisco, and was educated at Oxford. After leaving college he represented his father abroad, but came back to this country and for some time past has been a director and executive officer on the boards of the Commercial Cable and Postal Telegraph Companies, in both of which organizations he was highly esteemed for his native worth. When in New York he was a constant visitor to the Postal Building, in connection with his duties, and was also prominent in social life.

EUGENE LANGEN.

We regret to learn of the sudden death of Mr. Eugene Langen, one of the noted millionaires of Cologne, and one of the directors of the Otto Gas Engine Works, of Philadelphia, on the 2nd inst., of heart failure, at his country seat, Elsdorf, not far from Cologne. Mr. Langen was one of the largest beet sugar manufacturers in the world, acquiring by that business about $20,000,000. Beside this he had a large business and was a director of the Gas Motoren Fabrik Deutz, the largest of its kind in Germany. He had many decorations conferred upon him for his ingenuity and enterprise, one being from Emperor William I. He was in the United States in '94, when the firm of Schleicher, Schumm & Co. ceased to exist and the Otto Gas Engine Works were incorporated, which firm is now well known throughout the principal cities of the country. He was about 60 years old, and leaves twelve children, one of whom, Mr. Gustave Langen, is president of the above firm.

ELECTRIC LIGHTING.

THE MOORE ETHERIC LIGHTING SYSTEM.

In the early part of the year we gave a brief account of the results obtained by Mr. D. McFarlan Moore in the production of phosphorescent light in vacuum tubes by the utilization of current of ordinary low pressure, such as are customary on the regular low potential circuits and even from a few cells of battery. At that time we were enjoined from entering into the details by which these results were accomplished owing to the exigencies of the patent question, but the issuance, last week, of nine patents to Mr. Moore, now enables us to place before our readers the salient features of the methods employed by that promising young inventor.

The fundamental principle employed in the Moore system of

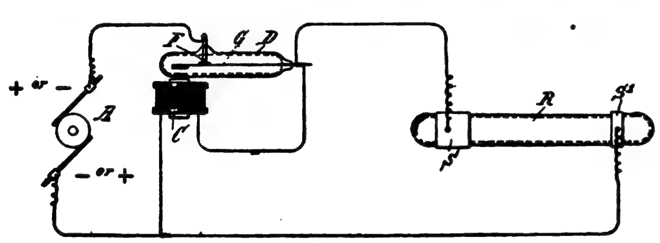


FIG. 1.

"etheric" lighting, as the inventor prefers to call it, consists in generating electric waves or vibrations suitable for producing luminous effects by interrupting the flow of electric current through a circuit of induction in a high vacuum as contradistinguished from a partial vacuum or one in which the rarefaction has not been carried beyond the point suitable for exhibiting luminous effects. The electric waves or vibrations so generated are made to produce luminous effects by action upon a receiver containing a rarefied gas.

In order to produce etheric or phosphorescent light there is required a high electromotive force with a short wave length. Heretofore high electromotive forces have been obtained by the utilization of counter electromotive force, due to the breaking of a circuit of high induction; but the degree of the counter electromotive force, or the final voltage obtained, as is well known, depends very largely on the suddenness with which the circuit is disrupted. As may be seen from Fig. 1, in Mr. Moore's apparatus the circuit through the magnet is disrupted at the contact F, placed within the vacuum tube D, the interposing dielectric being, instead of air which is a comparatively good conductor, a vacuum of almost infinitely high resistance and inserted in the circuit in a minimum space of time.

Another reason for the results obtained is that, as the vibrator is within a vacuum, it is free to move. That is, it has no air resistance and practically it is proved that it vibrates at a rate of between four and five thousand vibrations per minute, that is, three or four times as fast as the same vibrator would vibrate in the open air.

In the apparatus shown in Fig. 1, the light, of course, is produced at R. The vibrator tube consists of a glass tube enclosing a small bit of iron (the armature) attached to a metallic spring G, and in contact with the metallic contact point F. It is essential that the vibrator tube D should be exhausted to the very highest degree obtainable, while the tube which produces the light R should have a degree of exhaustion which is comparatively low, and which is that best suited for producing the maximum light. The circuit passes through the magnet C, whose self-inductive discharge is thrown into the tube R. The terminals of the tubes

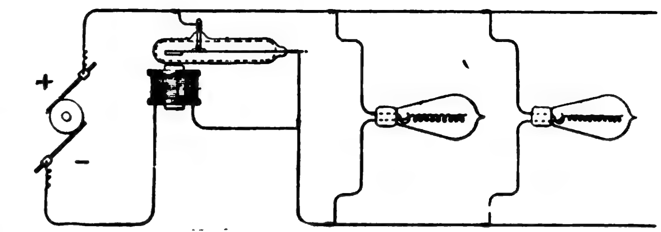


FIG. 2.

are coated with metallic paint, and to these coatings are attached the wires. It may be noted that the terminals of the light giving tube can be connected either directly in shunt around the break or around the terminals of the coil.

As is shown in Fig. 2, lamps containing filaments can also be operated with good results. The light produced at R, Fig. 2, is due to the action taking place between the two terminals within the bulb, but which are not in contact with each other.

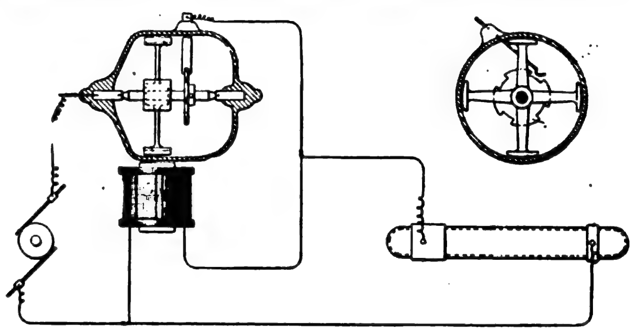


FIG. 3.

Numerous ramifications of the fundamental principle are immediately apparent and many of these are covered in the other patents recently issued to Mr. Moore. Thus Fig. 3 shows a form of interruptor in which a rotating armature has been substituted for the vibrating armature, while Fig. 4 illustrates the employment of a secondary coil, though Mr. Moore prefers the self-inductive effects of a single coil.

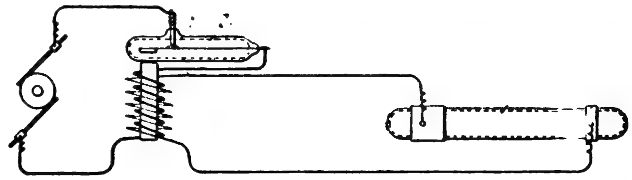
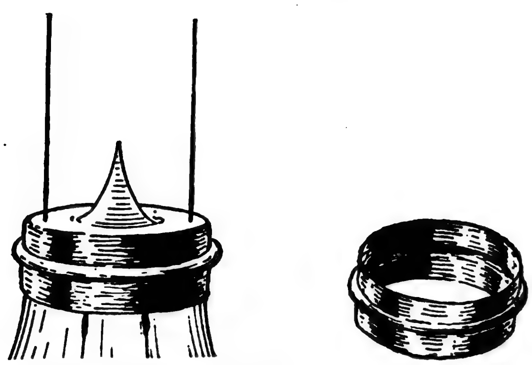


FIG. 4.

Heretofore, high potential and high frequency currents have been generated by specially designed machines, but with the apparatus above described an ordinary 110 volt current with an exceedingly small amount of inexpensive apparatus can be transformed into the etheric light. This immediately opens up the way for the practical adoption of the system for lighting buildings now wired for 110 volts, the current being transformed at the cut-out box from low potential almost directly into light without the generation of heat.

THE NEW "A-B" INCANDESCENT LAMP.

In our issue of last week we described the new arc lamp manufactured by the Adams-Bagnall Electric Co. of Cleveland. On this page is illustrated the incandescent lamp manufactured by the same company. It will be noted that the "A-B" incandescent lamp is constructed without the glass tip on the large end. This may seem a small matter upon first thought but further consideration will enable one to realize the important changes made.



FIGS. 1 AND 2.

The glass tip is made by welding a tube to the large end of the bulb and then sealing off close to the bulb when the air has been exhausted from it. In order therefore to get rid of this tip it is necessary to seal off at the other end. To do this it is necessary to abandon the usual glass mount. This therefore changes the entire interior construction of an incandescent lamp and the "A-B" lamp presents an entirely new appearance. The side of the

FIG. 3.—ADAMS-BAGNALL INCANDESCENT LAMP.

bulb is drawn inwardly in the shape of sharp pointed projections which take the place of the usual glass mount. The platinum wires are therefore conducted through the walls of the bulb at diametrically opposite points, as far apart as it is possible to place them, as shown in Fig. 1, and all trouble from short circuiting at this point is therefore avoided.

A new feature in the manufacture of this lamp is the application of a small brass ferrule to the lamp during the process of construction; this ferrule is shown in Fig. 2. When the leading-in wires have been attached to the platinum they are laid along the neck of the bulb in small grooves provided for that purpose. Over these wires and the neck of the bulb is then placed the ferrule which seats on the glass. The plaster or cementing substance is then placed in the open end of the ferrule, filling the grooves and depressions in the glass made for its reception. After this the bulb is exhausted and sealed off at the neck end; the lamps are placed in stock in this shape.

It can be readily understood that with an open end ferrule the plaster can be better applied to the glass than with a blind end base. The plaster being applied during the process of construction has ample time to dry and harden before the lamps can be shipped to market. This avoids all trouble arising from green lamps or lamps which will loosen at the base, which has been one of the greatest difficulties lamp manufacturers have had to contend with.

A lamp base is not constructed with a view to its being attached properly by plaster to the neck of a glass bulb; this additional brass ferrule seems to perform an important function in thus surmounting a serious difficulty in the manufacture of incandescent lamps. The fastening of the lamp base to ferrule is accomplished by mechanical means, and without loss of time waiting for the plaster or cement to dry. Care has been taken by the company to select a very handsome shaped glass bulb; as shown in Fig. 3. Patents have been awarded this month to the Adams-Bagnall Electric Co. covering this lamp and its method of construction.

LEGAL NOTES.

ANSWER FILED IN THE AMERICAN BELL—NATIONAL TELEPHONE SUIT.

In the case of the American Bell Telephone Company vs. the National Telephone Manufacturing Company and J. D. Leatherbee and Arthur F. Boardman, the defendants have filed their answer in the United States circuit court. The Bell company some time ago brought a bill in equity against the defendants, alleging that they are infringing upon the Berliner patent covering the microphone or transmitter, and ask that they be enjoined from further alleged infringement.

The patent in question is No. 463,569, was granted Nov. 17, 1891, and is owned by the Bell company. The defendants deny that Berliner was the first and original inventor of the microphone; also that the exclusive right to use the invention of the microphone was lawfully granted to the Bell company. The defendants further claim that the Berliner patent is invalid by reason of the delay in granting it.

The invention was made in 1877 by Berliner, according to the allegations of the plaintiff, and the defendants say there is no reason why they and the public should suffer from the long delay of the patent office in granting the patent.

SOCIETY AND CLUB NOTES.

NEW YORK ELECTRICAL SOCIETY.

The next meeting of the New York Electrical Society will be held at Columbia College on Monday evening, October 28, when Mr. P. B. Delany will lecture on "High Speed Commercial Telegraphy."

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The 100th meeting of the Institute, will be held on Wednesday, October 23rd, 8 P. M., at 12 West 31st Street, New York City, having been postponed from Oct. 16th, by direction of the President. A paper will be presented by Mr. Hermann Lemp, Jr., of Lynn, Mass., on the "Local Annealing of Hard Faced Armor Plates." A paper will also be presented by Prof. W. M. Stine, of Chicago, on "The Rating and Behavior of Fuse Wires." A meeting of Western members will be held the same evening, Wednesday, October 23rd, 8 P. M., in the rooms of the Western Society of Engineers, 1737 Monadnock Building, Chicago. Advance copies of the papers will be distributed at the meeting or mailed on request.

WESTERN VOICES IN PRAISE.

"The Data Sheets will be of value to many and are a good thing—send them along." Benj. H. Glover, Chicago, Ill. "I don't want to lose any of the Data Sheets, as they are invaluable to me in my position—running an isolated plant." I. H. Linn, Murphys, Cal.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

HART FLUSH SWITCHES.

The increasing demand for flush switches adapted to be set in a recess of the wall with the finished metal cover practically flush with the surface of the wall has led The Hart & Hegeman Manufacturing Company, of Hartford, Connecticut, manufacturers of the well known "Hart Switches," to bring out an improvement in this line of goods. They were the first on the market, we believe, with a flush switch made by attaching the switch to a rough cast plate for holding the switch to the wall, the whole

Figs. 1 and 3.

being covered and concealed by a finished thin sheet metal plate with flanged edges held in position by the switch handle which set in a recess in the face of this plate, thus avoiding any screw heads on the surface of the finished plate.

These finished plates being made of thin metal were very liable to become injured in use, and at the best were not perfectly flat, and in the right light many appeared wavy. The new plate illustrated in Fig. 1, is made of solid plate brass, $\frac{1}{8}$" thick, with

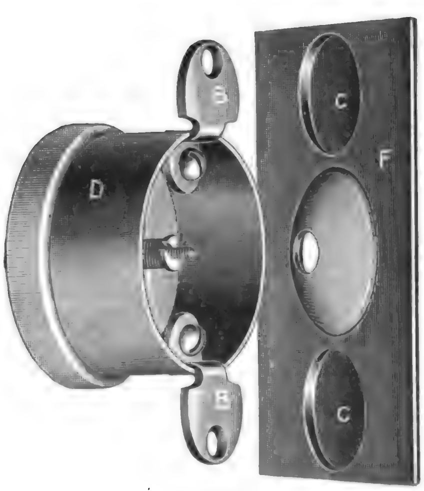


Fig. 2.

edges milled to a bevel. The switch itself is attached to a brass ring D, Fig. 2, having ears B for fastening it to the wall. When this ring with switch attached is screwed to the wall the ears project their thickness from the face of the wall and are accommodated by pockets C in the back of the face plate F, allowing this plate to set back against the wall. In all flush switches made on the old plan, there is always a variation in the distance from the plate to the porcelain base of the switch, and when the handle is screwed on it frequently binds on the plate, making it turn hard and oftentimes breaking the handle, or else it does not screw down far enough to hold the plate in position, and allows it to rattle when the switch is turned.

This difficulty is now obviated by the self-adjusting handle shown in Fig. 3. The collar A of this handle has a vertical movement with reference to the body of the handle of more than $\frac{1}{16}$" and is held downward by a flat spring which it encloses and conceals. This spring-pressed collar holds the plate firmly against the wall with an easy, elastic pressure. The shape of the handle is easy to the hand, and the large section of material around the metal interior gives it great strength. The material is stronger than that heretofore used. The range of movement of the collar A compensates for all variations liable to occur in the distance from the face of the plate to the porcelain base of the switch. This adjustment makes all handles, switches, and face plates interchangeable, with no danger of the handles binding on the face plates, either breaking the handles, or causing them to turn hard, or of the face plates being too loose. This adjustment is especially advantageous in gang plates. Single plates for all sizes of the Hart switches, and gang plates for any number of switches are now furnished, made as described above and with self-adjusting handles.

The dimensions of the different plates is given in Catalogue B. Special plates of any required size are made to order. Gang plates are frequently furnished with bell buttons or automatic gas lighting buttons set in the plate. Plates in any of the standard finishes are carried in stock and special finishes to match other hardware are furnished promptly.

NEW YORK NOTES.

Messrs. H. B. Coho and Company are installing in the New York *Herald*, 35th street and Broadway, four 60 k. w. multipolar Eddy generators of their new type. The mechanism of the *Herald* is run almost entirely by electrical power and the generators will be required to do very severe service.

PHILADELPHIA NOTES.

Frank H. Stewart & Co., of 35 North Seventh Street, have placed upon the market a new lamp called the "Stewart," which is made in all voltages, candle powers and bases, with either straight, half twist, coiled or anchor filaments.

ADVERTISERS' HINTS.

Frank H. Stewart & Co. make it their business to furnish electric switches for every possible use.

The Faries Mfg. Co. sell a lamp holder, "The Universal," that shifts the light instantly right where it is wanted.

Hanne Bros.' wire reels are the latest thing in wire economies. They save an immense amount of time and trouble.

The Adams-Bagnall Electric Co. have a new incandescent lamp which is a great success. Take one home in a box and try it.

Incandescent Lighting Supplies are advertised by the Perkins Electric Switch Mfg. Co. The Perkins goods are standard.

Electric Signs are becoming popular, if they are not already so, and it is well to know that the Stancliff-Orgill Mfg. Co. supply them in all varieties.

"Steel is Steel" say the Graham Equipment Co. and they also tell how tons of coal may be saved each month by the use of their street car equipment.

Flush Switches of every variety and possessing many excellent features, are being manufactured by the Hart & Hegeman Mfg. Co. Their new catalogue "B" describes them all.

The Central Electric Company stocks "everything from the ground up" and makes prompt shipments of anything needed in electric railway construction and maintenance.

Safety Insulated Wires and Cables still maintain their high grade quality. There is much of this wire in use as railway feeders, and there will be a good deal more in a very short time.

Air-Brakes for street railway use are becoming less and less a novelty. The Standard Air-Brake Co. has done much to bring this about. Their apparatus may be said to be approximating perfection.

"In Time of Peace Prepare For War!" Now is the time to buy a snow plow. The Taunton Locomotive Mfg. Co. are building them for the hardest kind of service. They claim superiority to all others in many points.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

Vol. XX. OCTOBER 30, 1895. No. 391.

The Old Way—Five Horses Towing Two Boats On The Erie Canal.

ELECTRICITY ON THE ERIE CANAL.

I.

IT was natural that when steps were taken to utilize some of the energy of Niagara and distribute it electrically, the idea should occur to progressive men to apply a portion of the power to the Erie Canal, which has long needed the assistance of better methods of propulsion for its boats. In fact, the canals of the whole country have stagnated for many years owing to the fact that the use of steam on the railroads has deprived them of patronage and established conditions against which the mule could not contend. When the last official statistics of canals in the United States were compiled, there were 4,468 miles of canal that had been built at a cost of $214,000,000. Of this length, 1,953 miles had been abandoned and a large proportion of the other mileage could not earn, operating expenses. The Erie Canal cost originally about $7,500,000 and improvements on it represent a total of $51,500,000, but with mule power applied to 95 per cent. of the boats, and with a depth of only 7 feet, it could not continue, in competition with the well-organized service of the New York Central Railroad, the work of building up the internal commerce of the state and nation. It is now proposed to spend nine million dollars in deepening the canal, but meantime some very interesting and important work is being done in the application of electricity.

II.

In 1893 the New York State Legislature organized a test to be made of electricity as a method for the propulsion of canal boats. Mr. F. W. Hawley, of New York, was satisfied that electricity could be successfully applied to this purpose and arranged for a public trial. It took place November 18th, 1893, between locks 63 and 65. This spot was chosen because it contained several sharp turns and would, therefore, present a severe test. The "Frank W. Hawley" was an ordinary steam canal boat equipped with a dish-pan screw. To this two Westinghouse motors, 25 H. P., street railway type, were connected. The current was conveyed from a nearby central power station by a pair of wires suspended over the water way, and was received by the motor through two underbearing trolley poles. A great many State officials, capitalists, electricians and business men were present. The boat was crowded with spectators and carried in addition 175 tons of sand. Gov. Flower threw over the lever of the controller and the "Hawley" began to move against the current. A speed approximating four miles an hour was attained. On its course it passed through a lock and under a low bridge and then returned to the starting point, reaching it at 12:30 P. M. About 22 H. P. were used in running the boat. The test was universally pronounced a success. It was the first application of electricity to the movement of commercial canal boats in this country.

It was expected that, at that test, a flexible wire attached to an over-running trolley would be used, thus facilitating the lateral movement of the boat, the wire being reeled upon the deck, the automatic reel taking up the slack as occasion required. This appliance not being received, it was necessary to improvise a method of connecting with the trolley wires, which was accomplished by the use of two rigid steel poles taken from the cars of the Rochester Railway Company.

The work has now been attempted again more thoroughly and scientifically at Tonawanda near where the Erie Canal connects with the Niagara River and Lake Erie; and there is every promise of useful and lasting results. Mr. Hawley has again given the matter his personal attention, and the system used is that of hauling from the bank as distinguished from driving the boat by a propeller immersed in the water of the canal. The system is that of Mr. Richard Lamb, C. E., and has already been described in our pages in connection with its use elsewhere for canal work and logging in swamps. Our illustrations afford an excellent idea of the modus operandi.

III.

Brackets are erected upon posts or supports, and saddles are placed upon the brackets having insulating material between them. The saddles are designed to prevent short circuiting of the electric current by rain. A bracket is also provided to support the lower or traction cable. This is not insulated, but at intervals along the line some of these brackets are grounded. A $1\frac{1}{4}$ inch steel cable is supported upon the upper saddles and a $\frac{5}{8}$ inch steel cable upon the lower. In canal boat towing, the cable is placed on the inward side of the tow path. The bearing cable is

placed at an elevation of sixteen feet from the ground, and the traction cable 8 feet below it.

The motor truck is made with two deep grooved wheels to run on a cable, having a horizontal axle between them and below their centre line. Upon the axle is suspended a hanging frame having attached to it an elliptically grooved sheave which is revolved by means of a worm or wedge-gearing, driven by a 15-kilowatt electric motor with vertical shaft, all attached to the swinging frame of the car. By taking three turns of the ⅝ inch cable around the elliptical grooved sheave when the electric motor revolves the gearing, the sheave winds up, and at the same time pays out the ⅝ inch cable, thus pulling along the car. The motor in this way gets its tractional friction independent of the weight of the apparatus.

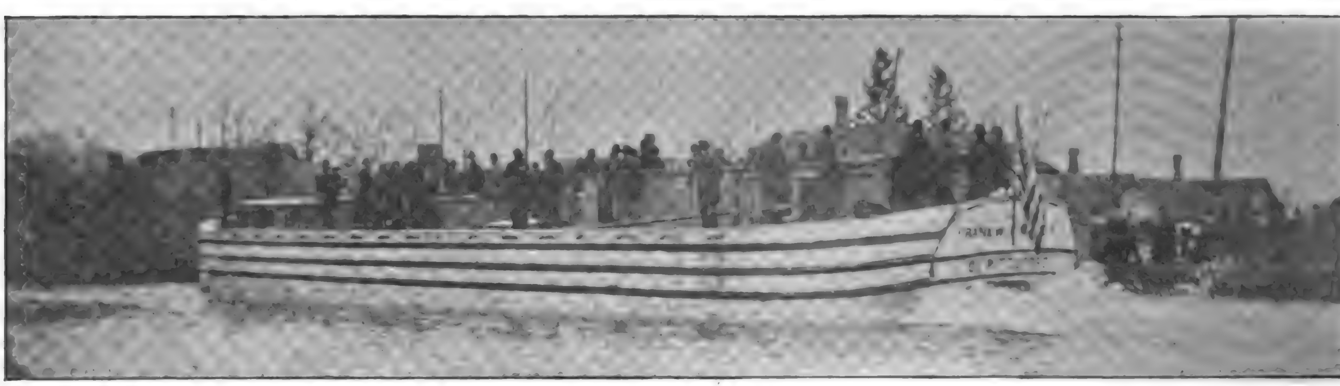
The current is returned through the traction cable which is grounded at intervals, giving a combined ground and metallic conductor from the return current. A five hundred volt current is used, furnished in this case by the new Niagara Falls and Buffalo trolley line. It is taken from the main cable through the wheels, thence through the axle to the axle-box of the hanging frame. Here an insulated copper wire connects it with the rheostat. The return current is passed through the axle of the elliptical grooved wheel; thence on to the ⅝-inch wire to the brackets; thence through a wire to the ground; thence to the terminal of the generator.

When the motor reaches the bracket the traction cable is lifted from the saddle momentarily, and the car can take a new course. Hence it is not limited to operating in a straight line. The saddles are made so that the wheels leave the cable and ride over on their flanges in the channels of the saddles made for straight line or right and left deflections. The main cable is used as the electrical conductor. It is insulated at the brackets by insulating material placed between the saddle and the bracket, and the current is prevented from passing down the frame of the motor by insulation at the point on the frame where the axle-box joins the frame proper. The points of insulation are provided in their construction with hoods to shed water.

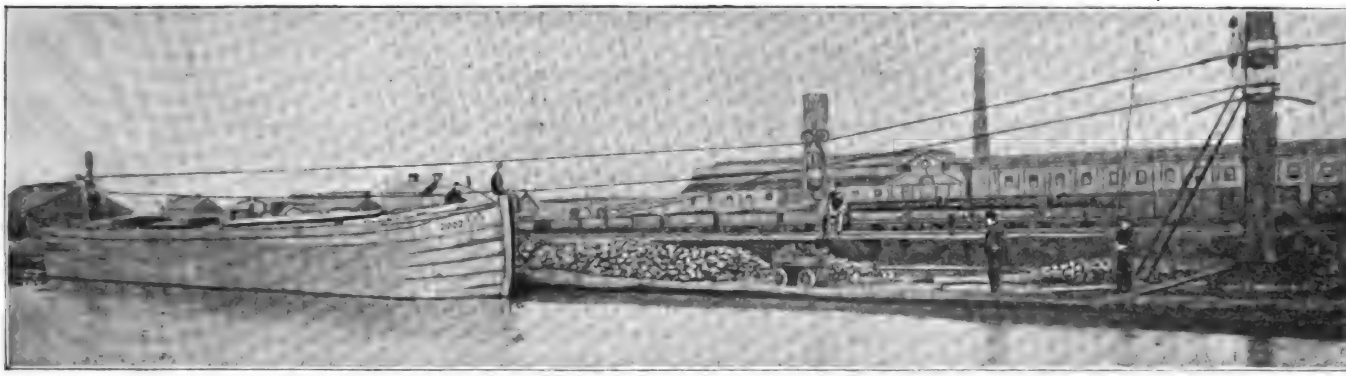
The worm or wedge gear used, differs from an ordinary worm gear in that it has more than twenty times the bearing surface of an ordinary worm and wheel, moves two teeth of the gear wheel at each revolution of the worm, and works on the principle of a wedge rather than an inclined plane. The worm gear especially made for this electric motor, is designed to work both ways, and has ball-bearings at either end of the worm, to lessen the friction and thrust. The gear wheel, worm and ball-bearings are encased in a jacket filled with oil. Thus the minimum loss in power is effected between the electric motor and the elliptical grooved wheel. The gearing is necessary in order to lessen the speed, as the electric motor is run at 1,240 revolutions per minute.

The rheostat is made to carry the current through it as well as to regulate the speed and reverse the current, and has an automatic switch. Four insulated copper wires armored with steel wire form the cable that conducts the electricity from the bearing cable to the rheostat on the boat and back to the motor, and at the same time acts as the tow line. The upper end is clamped to a ring

STEAM CANAL BOAT ON ERIE CANAL, WITH CONSORT.



THE "FRANK W. HAWLEY," FIRST ELECTRIC CANAL BOAT ON THE ERIE CANAL, PROPELLED BY CURRENT FROM TROLLEY AND WITH MOTOR DRIVEN PROPELLER.



FIRST EXPERIMENT OF LAMB SYSTEM ON DELAWARE AND RARITAN CANAL AT TRENTON, N. J.—SHOWING HOW MOTOR IS HUNG WHEN TRAVELING.

that runs on a traveller situated on the frame of the motor about the lower part of the elliptical grooved wheel. A long steel clamp, with toggle joints is used to hold the towing cable at any point desired, and has a ring in one end to which is attached a short length of rope, which is made fast to the sampson post of the boat. The end of the towing cable is carried to the rheostat on the boat, where it is coupled to a similar piece of cable wired to the terminals of the rheostat. The coupler is designed so that it is impossible to join other than the right wires together, and the contact is made quickly and securely.

When a motor is to be run without any boats in tow, its rheostat and conducting-wire-tow line is placed upon the motor, and a driver seated on a seat on the electric mule operates the same.

IV.

It may be stated that this new test has been made under the authority and direction of the Superintendent of Public Works, with the approval of the State Administration. The Legislature of this State, by an act, authorized experiments to be made in applying electricity to the propulsion of canal boats; it subsequently authorized the Public Works Department to enter into a contract with the Cataract General Electric Company for the equipment of the canals with some system of canal towing, but first to be duly approved by the Superintendent of Public Works. A contract drawn by Governor Flower was entered into with the Cataract General Electric Company, which was authorized during the term of 50 years to construct, maintain and operate a system of canal boat propulsion upon all of the canals of the State of New York It permitted the use of either or both banks of the canal, and all canal lands, provided that the present method of towing was not interfered with. It has also allowed the Cataract General Electric Company to carry its power mains over all canal lands, through cities, villages and towns, along its line for local distribution, thus relieving the company from the necessity for municipal action when seeking to enter to supply electricity.

The Cataract General Electric Company entered into a contract with the Erie Canal Traction Company to apply and operate the towing line at a cost not to exceed $3,000,000, which amount was subscribed.

It being necessary that the system should be first approved by the Superintendent of Public Works, the Cataract General Electric Company made this its second test of the value of electricity for the propulsion of canal boats. The first system submitted and tested was fully approved by the State authorities, but the Cataract General Electric Company are convinced that the cable way or traction system is much superior.

V.

The developments possible with electricity are suggested by recent events. Six steel canal boats have lately been constructed at Cleveland, and have already made one trip to Lorain, Ohio, to New York City and Brooklyn, have returned to Cleveland, and are on their way down the canal on their second and last trip this season. They are 96½ feet long, 17 feet 11 inches wide, and 10 feet molded depth, as to five of them in which there is no self-propelling power. The other, a steamer, is 95 feet long and of the same dimensions otherwise, as the other five. The steamer is said to have cost $12,000, and the other boats $5,500 each, which is about double the cost of wooden boats. The steel canal boats, however, can obtain marine insurance for lake navigation, impossible for wooden boats of the present type, and in this respect the steel canal boats have a big advantage. The Cleveland Steel Canal Boat Co., who own the boats, have, as a result of the first trip, it is said, decided to have 24 more boats built, to be ready for use next spring. These will all be 98 feet long and built to carry 260 tons on the six feet draft, or 30 more tons than the present boats can carry. The steamer, it is

VIEW ON ERIE CANAL NEAR TONAWANDA, SHOWING LAMB SYSTEM OF ELECTRIC CANAL BOAT PROPULSION BY CABLE HAULING.

said, will be given an engine capable of developing 240 H. P. and which is double the power of the first steam canal boat. The freight rate from Cleveland to New York is said to be about three times greater than wooden boats obtain in the canal only, and yet the distance from Cleveland to Buffalo is but 174 miles, while from Buffalo to New York it is 500 miles. It is said that the fleet of 30 boats, in fleets of five non-powered boats and one steamer, will make a round trip in five weeks, so that one fleet will start from Cleveland and another from New York, each week. It is also said that the capacity of the 30 boats, and the speed at which they will travel will be equivalent to an ordinary freight train leaving Cleveland daily, during the season of navigation.

VI.

Mr. Alexander R. Smith, Secretary of the Executive Canal Committee of the Commercial bodies of the State,

Lamb Electric Cable Hauling Pole on Erie Canal.

who is also the editor of the *Canal Defender*, in his letter of acceptance to attend the test made the following statement :—

"At the maximum rate permissible, under the company's charter, horse and mule boatmen will save 82 per cent. of the present cost of towage, and steam canal boatmen will save 55 per cent. on present cost, if electrical power displaces horse, mule and steam. It now costs 12 cents per mile per horse or mule boat propulsion in the Erie Canal, or $42.24 per boat for the 352 miles from Buffalo to Albany. Allowing a rate not to exceed 2 miles an hour, in the present canal, the cost of electrical power will not exceed $7.97 from Buffalo to Albany, per boat. It costs not less than 5 cents a mile, per boat, at present by steam power or $17.60 from Buffalo to Albany, as compared with $7.97 by electricity. This is estimated on 20 horse power per boat, which was the amount required to tow the six Cleveland steel canal boats at the rate of three miles an hour, and, moreover, it is stated that an electrical horse power is about 33 per cent. stronger than a steam horse power (*sic*.)

"If the voters at the next election adopt the bill to improve the canals, three miles an hour will be practicable in the Erie Canal, and with even less horse power than is now required. Making no reduction in the present required horse power, however, the cost per boat will then be 33 per cent. less than at present, or but $5.31 from Buffalo to Albany. This will effect a saving of 88 per cent. to horses and mule boatmen and 70 per cent. to steam boatmen below the present cost. It is more than likely that light boats can be moved from Albany to Buffalo at the rate of six miles an hour and with no more horse power than is now required, and for only half the time, thus effecting a still further saving in the improved canal, of 50 per cent., or making it possible to tow a light boat from Albany to Buffalo for $2.66.

"The effect upon canal transportation that such savings will accomplish is inconceivable. It will not only revolutionize canal transportation methods, but will effect such enormous reduction and afford such an increase of trips as to probably belittle any prediction that I may venture."

Mr. Hawley in a recent interview said that he hoped his company would at no distant date be supplying power thus to no fewer than 3.000 canal boats. He also pointed out that bridges and locks would be operated in the same manner, and that the canal would be lighted. It would also be entirely feasible to carry tap wires into the surrounding country for lighting, power and trolley work. Mr. Hawley has fought his campaign with immense energy and persistence, and not the least of his difficulties has been the unreasoning prejudice of the old school canal boatmen, who do not yet perceive the fact that electricity is to reclaim for them the field in which they earn their bread and butter.

VII.

In connection with this important work on the Erie Canal, it is interesting to recall the manner in which Mr. Lamb came to hit upon his plan as there adopted. He has a large lumbering industry in the Dismal Swamp, and it was in conjunction with this business that he invented his steam and electric cableway. There was no system in the market for getting logs from the swamps, except one that employs only one span of a cable and is very limited in the distance it can haul. Practically 500 feet is as far as it worked. It requires a large and complicated drum engine and boiler, and is in consequence very expensive for the service rendered, and it also requires a large crew to work it. Mr. Lamb conceived the idea of passing the supports of the cable by means of scientifically constructed brackets placed upon the trees as supports. The cars on which the logs are hung are hauled upon the cable by a half inch diameter, endless cable, run upon sheaves on the brackets. He had his plant made at the works of the Trenton Iron Co., of Trenton, N. J., the largest cableway manufacturers in the world. The plant proved an entire success, and Mr. Lamb was enabled to get logs from the swamps heretofore practically inaccessible. It occurred to him that he could take the same boiler and engine, and deliver the same power a far greater distance into the swamps, by sending the power through the bearing cable in the form of electricity, and that unlike in steam cable systems, it would not have to be run in a straight line. Mr. Lamb found on investigating the state of the art of telpherage, that other systems had failed owing to the fact, that to obtain the necessary weight to secure tractional friction between the wheels and the cable, the motor had to be made heavy, which sagged the cable and increased the incline of the cable which is met on approaching the supports. He overcame this difficulty by building a machine that would carry its tractional friction independent of the weight of the apparatus. This he did by having a flexible steel cable anchored at both ends. Several

Richard Lamb.

revolutions of this cable are made about an elliptically grooved wheel, which is turned by an ironclad electric motor, as already described. In this way the motor is hauled beneath and upon the bearing cable. The effect is like a steam windlass on a boat, where one end of a cable is anchored and several revolutions of the rope are taken about the capstan, and the slack is hauled in; or, like an elevator where a sufficient number of wraps has been taken about the drum to provide friction to sustain the weight of the car. In the Lamb Electric Cableway, the hauling cable is kept parallel with the bearing cable. Hence, when the motor is climbing the inclination of the rope, the direction of the pull is in the best possible direction to save power. This feature insures for the system a great future for mountain cableways where steep grades are to be overcome. The original plant that was built was erected for trial on the sides of the Delaware and Raritan Canal as illustrated already in THE ELECTRICAL ENGINEER.[1] Seeing some mules hauling a canal boat at a slow pace near his work, Mr. Lamb naturally thought of relieving their burden by taking their tow line. On testing canal boat towing, the system proved from the start to be excellent. Subsequent tests were made in pulling the boats around sharp curves, which also proved entirely satisfactory. Mr. Lamb then put up his plant in the swamps of North Carolina and later in Virginia, where he is now hauling logs. With a plant generating its electricity by a 20 horse-power engine one can go into a swamp and haul out logs for a distance of one mile, pulling in the logs from either side of the cable for a distance of 500 feet by a lateral hauling device, also invented by Mr. Lamb. He has also invented an electric saw that takes its current from the main cable of his electric logging rig. Its crew consists of a foreman who rides a motor, and thus can superintend all branches of the work, an engineer who fires the boiler, a terminal man who unloads logs and cuts wood for the engine, three men and two tree sawyers, in all eight men. Both in the forest and on the canal Mr. Lamb has designed the system so that no knowledge of electricity is necessary on the part of the workman.

Frank W. Hawley.

ELECTRIC POWER FOR ANGELS CAMP, CAL.

AN electric power plant is to be built on the Stanislaus River by Addison Bybee, of Indianapolis, Newell S. Wright, mining engineer, and Messrs. Street, Lambe, Bishop and Dietrich of New York. Power will be distributed to various mines. It is said that the apparatus will be supplied by the Jenney Motor Co. of Indianapolis.

ELECTRIC POWER FOR ALAMEDA COUNTY, CAL.

Articles of incorporation of the Pacific Transmission Company have been filed. The authorized capital stock is $3,000,000, divided into thirty thousand shares of $100 each. The company has been formed for the purpose of building electrical and steam plants at the coal mines at Corral Hollow in Alameda county. It proposes, in the near future, to furnish electric power to Oakland, San Jose, Stockton and ultimately San Francisco. There is every probability that the contract for the construction of the plant will be let to the General Electric Company.

1. For a full discussion of electric canal boat work, see Martin & Sachs "Electrical Boats and Navigation."

LITERATURE.

Electrical Measurements. By Henry S. Carhart and George W. Patterson, Jr., Boston, 1895. Allyn & Bacon. 344 pp., 5 x 7. Price, $2.

It has been truly stated that "science is measurement," and of none of the sciences is this truer than of electricity. The means for ready measurement of electric forces, and the accuracy and rapidity with which these measurements can be carried out are perhaps greater than in any other of the forces of nature which have thus far been "sized up." The work before us constitutes a graded series of experiments adapted to the use of classes. The authors have confined themselves entirely to quantitative experiments, and the object has been to give the student instruction in general measurement methods, rather than in specific departments, which are more extensively treated in special handbooks on the subject. In this manner the authors show the best and most improved methods of measuring resistance, current, electromotive force, quantity and capacity, self and mutual induction and magnetism. The chapter on the measurement of self and mutual induction will be found particularly useful, and of more than usual value in these days of alternating, single and polyphase currents. Throughout the work the descriptions of the methods of measurement have been supplemented by actual examples, which are always so useful in fixing the ideas of the student.

We can commend this work very highly to all teachers in elementary laboratory work.

WORK OF THE U. S. SIGNAL CORPS.

The annual report of General Greely, Chief Signal Officer, contains some interesting points. He speaks of the advantages derived from the use of the bicycle in repairing the telegraph lines. In one case a break on the line was reached two miles from the station in twenty minutes—less time than would have been consumed in obtaining a mount. At another station, Taylor's Ranch, Utah, the bicycle has resulted in a single year in a greater saving to the Government than the cost of the machine.

Special attention is given by the Signal Corps to the suitable equipment of its flying telegraph trains. Flying telegraph trains equipped as far as practicable with the most modern appliances are situated at Fort Riley, Kansas; Fort Grant, Arizona; Fort Sam Houston, Texas; Fort Leavenworth, Kansas, and the Presidio, San Francisco, Cal. The experiment of reeling out and recovering wire and outpost cable by bicycle automatically has been concluded, and this corps now has a bicycle equipped with an automatic reel for the purpose that works perfectly. The same automatic device is now being fitted to an outpost cable cart, three of which have been ordered, from which are confidently anticipated good results, as in the case of the bicycle. This will give the Signal Corps an equipment superior to that of any other country for rapidly paying out and taking up a line, the operators being at all times in communication with the base. Each section of the field train will eventually be supplied with bicycles and cable carts fitted with automatic devices.

The instruction of enlisted men of the Signal Corps at Fort Riley, Kansas, has been continued with satisfactory results. The theoretical instruction occupies four months and the practical two months. The course embraces electricity, telegraphy, telephony, military signaling, field surveying, map-making, and photography, and is designed to make each man an expert signalist and good telegraph operator, and qualify him to make rough field sketches or photographic reconnaisances.

Most complete work in signaling was done by the special detachment at Fort Trumbull, Conn., in connection with the Signal Corps of New York and Connecticut during the practice of the New York Naval Reserves. Messages by flag and heliograph were transmitted rapidly and accurately both in the Morse and general service codes.

DEATH FROM THE SHOCK OF THE ELECTRIC TORPEDO.

Under date of Managua, Nicaragua, C. A., Sept. 21, Mr. Wm. Lee, M. E., writes us as follow:

I have just read your article in the issue of August 28 on the torpedo. Allow me to say that I have seen torpedoes and electric eels in the delta or better known as the Oronoco Valley, Venezuela. I saw a mule killed by an eel once and saw a woman and a large boy, her son, about 18 years old, both killed by a torpedo. The two were on the bank of the lower Oronoco below Ciudad Bolivar, and were killed by the same fish. In crossing ponds I have frequently seen mules knocked down by electric eels which are quite numerous in that delta. I have seen them in pools dried up and in a decaying state and no turkey buzzard would go near them. I could relate many queer stories about them if time and space would admit. Everybody is afraid of these electric fishes and the turkey buzzard has no use for them.

Electric Lighting.

THE MORECAMBE, ENG., GAS ENGINE ELECTRIC LIGHT STATION.[1]

The first gas-engine station for the generation of electric energy for public supply in the United Kingdom was that which was erected at Morecambe, in Lancashire, in 1892. And this station possesses a further interest, from the fact that it was almost from the first driven by engines supplied with Dowson producer gas. Only for a short time at the start was town gas used in this station; and we understand that the Dowson producers have been continuously used from the time of their introduction.

At the present time the equipment of the station comprises the following details:—There are three Dowson gas generators, two of 75 H. P. and one of 150 H. P. capacity. These are connected to a gas tank, having a maximum capacity of 1,500 cubic ft. Steam for the gas generators is raised in one or the other of two small vertical boilers. The engine plant comprises one Crossley gas engine, of about 100 H. P., and three "Stockport" gas engines, each of 25 H. P. The dynamo plant includes two small two-pole continuous-current generators, one large machine of similar pattern, and one six-pole machine, which is partially used as an

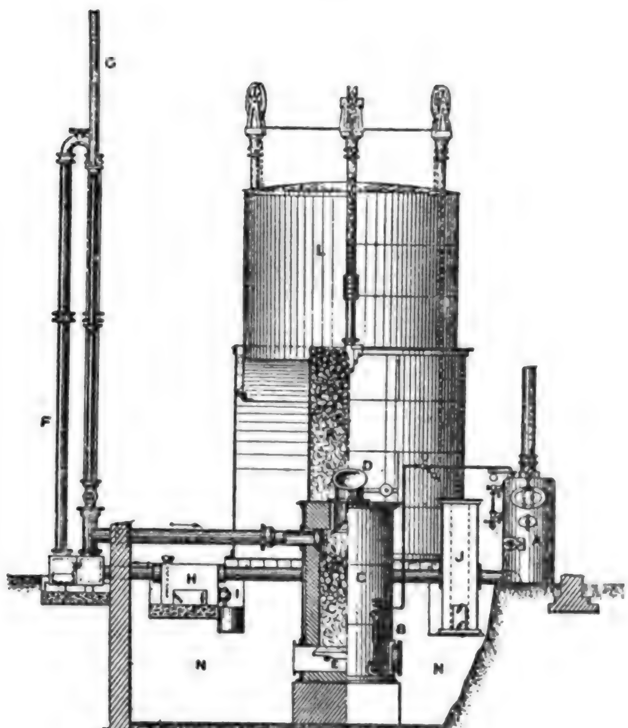


Fig. 1.—Dowson Gas Generating Plant.

alternator and partially as a continuous-current generator. Each of these machines is belt-coupled to a separate gas engine, the 100 H. P. engine driving the six-pole machine. There is a small storage battery, comprising 72 E. P. S. cells of the K type.

As the chief interest in this station arises from its gas-engine equipment, we will devote our chief attention to the details of this, reserving for the conclusion a few remarks upon some of the electrical features.

Fig. 1 shows an elevation and vertical section of one of the units of Dowson gas generating plant, together with the gas tank and connecting pipes, &c. The generator or producer itself is shown at C, and it consists of a brick-lined furnace, wherein anthracite, supplied through the door D, is fed with a blast of admixed steam and air. The steam is generated in the boiler A, and is usually superheated on its passage from the boiler to the steam range or pipe O. Through the imperfect combustion of the incandescent carbon or anthracite, and the dissociation of the steam, a diluted fuel, known as Dowson water-gas, is generated in the furnace C. These admixed fuel gases, comprising hydrogen, carbon monoxide, carbon dioxide and nitrogen, in very varying proportions, according to the conditions of generation at the moment, are passed from C through the gas pipe to the coolers F. These coolers consist of a stack of vertical cast-iron pipes, giving sufficient radiating surface to reduce the temperature of the gas to ordinary limits. From the coolers the gas passes through the hydraulic box or water trap to the sawdust scrubber J, and thence to the coke scrubber, which in Fig. 1 is shown to be inside of the gasholder, at K. Passing up through the coke scrubber the gas will collect in the small gas tank or holder L, from which it is drawn off as required for use in the engines. More commonly, and in the actual plant at Morecambe, the coke scrubber is separate from

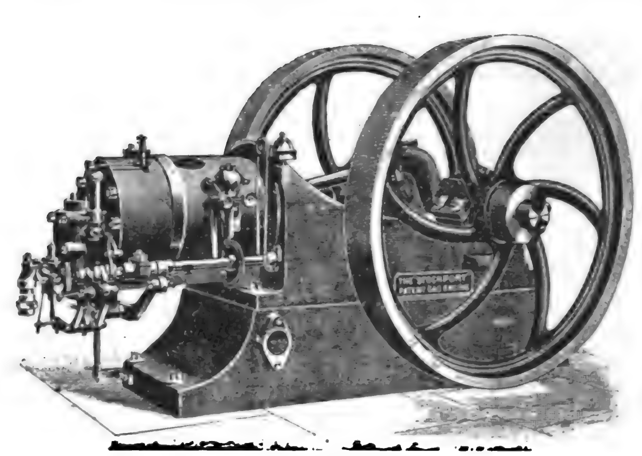


Fig. 3.—The Stockport Gas Engine.

the gasholder. A view of the Morecambe gas-house is shown in Fig. 2.

The steam in the boiler is generated at a normal pressure of 60 lbs. per square inch; and it is not found to be economical to reduce this pressure very considerably on light loads. The quality of the gas very much depends on the boiler pressure, or rather, on the pressure of the steam blast. Too great a reduction of pressure generates poor gas. Normally, about 120 lbs. of coke per hour is burned in the working boiler.

The sawdust scrubber is re-charged every three weeks, and the coke scrubber once only every six months. It has been found in other places that a more frequent change in the charges, especially of the sawdust, is advantageous.

The gasholder is of 1,500 cubic ft. capacity; it is thus only large enough to serve as an equalizer of the pressure, for full load on the station will empty it in ten minutes if a gas producer is not working.

One of the "Stockport" engines at Morecambe is shown in Fig. 3. These engines are rated at 25 H. P. each, they run at 180 revolutions per minute and are coupled by cotton belting to the dynamos. The belts are fastened by Lagrelle's fasteners; and they have run for three years with success. There are no fly-wheels on the dynamo shafts. Leather belts were tried, but were found to ride off the pulleys; link belting was also not quite so satisfactory as the cotton kind.

The three "Stockport" engines are started by running the dynamos as motors from the cells or 'bus bars. The large 100 H. P. Crossley gas engine, which has more recently been erected in the station, is started by an explosion starter, which gives six explosions before it is necessary to draw gas from the mains. All the engines are fired by ignition tubes of wrought-iron steam

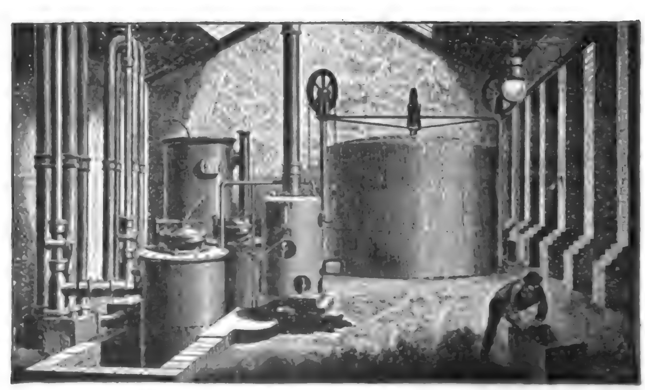


Fig. 2.—Gas Generator, Morecambe, Eng., Electric Light Station.

pipe, plugged at one end. These cost about 1.5d. each, and last for about 50 hours; which compares very favorably with the magnitude of this item at some other stations. Each engine has a separate exhaust up-take, passing vertically from the engine through the well-ventilated roof. There is a silencer, consisting

1. Abstract from the London *Electrician*.

of a wrought-iron cylinder filled with shingle, capping each up-take exhaust pipe.

We may make a few remarks, in conclusion, on the matter of the cost of production of electric energy on this system of generation. Coal is purchased for about 18s. per ton, and at that rate the average cost of fuel per unit metered out of the station, during three months of working, was about 0.5d. per unit. On short runs Mr. Collinson has succeeded in bringing the cost down to 0.3d. per unit. The normal load on the station, in lamps wired, is 3,000 lamps, including the equivalent of some 40 small arc lamps. A small trade in motor work is done in the town, but there is not excessive demand here for motive power. Power for motors is metered at 7d. per unit; but for all lighting, power is supplied by contract at 25s. per annum per 16 C. P. lamp, and the equivalent for lamps of other power.

MUNICIPAL LIGHTING AT SPRINGFIELD, ILL.

SUCH interest is manifested at the present time in the subject of municipal lighting, and so much is written concerning it, that it may not be out of place to record the rather unique experience of Springfield, Illinois.

About five years ago the city of Springfield entered into a contract with the Springfield Electric Light and Power Co. to furnish arc lamps for street lighting at $137.50 per lamp per year. This arrangement was not altogether satisfactory to the city, and, moreover, the lighting company, which also controlled the gas works, refused to run incandescent lamps for private use on the ground that it was unable to do so at a profit; it also claimed that the cost of running one arc lamp was $117 per year, and that consequently the price of street lighting could not be reduced.

This conduct on the part of the company did not tend to endear it to the citizens of Springfield and they cast about for other means of obtaining electric light. Springfield desired a municipal plant, but since the city debt had already reached the limit allowed by law this was impossible. At this juncture sixty citizens of Springfield offered to loan their credit to the city to the amount of $1,000 each. They organized the Capital Electric Co. with a capital of $60,000, erected a lighting plant, and made a contract with the city. This contract specifies that the Capital Electric Co. shall furnish three hundred 2,000 C. P. arc lamps at $118.33 per lamp per year, on a moonlight schedule furnished by the city, and that the city shall have the right to annul the contract at any time if it so pleases.

The Capital Electric Co. leases the plant to McCasky & Holcomb, who are paid $60 per lamp per year, for street lighting, by the Capital Electric Co. and in addition the Capital Co. pays the lessees seventy-five per cent. of the gross receipts from commercial lighting. The difference between $118.33, received from the city by the Capital Co., and $60 which it pays the lessees, or $58.33 per lamp per year, and twenty-five per cent. of the gross commercial earnings is held in trust for the city by the Capital Co. When the amount of this fund equals the cost of the plant, the plant will pass into the possession of the city, and the work of the Capital Electric Co. being finished it will probably pass out of existence. Thus the city virtually buys the plant on the installment plan.

This seems to be a rose colored prospect but it is just here that the old company steps upon the scene and the trouble begins. When the city made the contract with the Capital Electric Co. its contract with the old company had yet five years to run. The new company opened its plant on the first of last June and both companies furnished street lights every night during the month. Then the secretary of the old company, acting as a private citizen, obtained a temporary injunction restraining the city from paying any money to the new company on the ground that it had no right to annul its contract. On the other hand the city takes the position that a city council has just as much right to annul a contract made by a former council as it has to repeal an ordinance; thus placing ordinances and contracts on a similar, though not equal, footing. Both sides have secured the services of eminent lawyers and it is expected that there will be a bitter fight in the courts.

In this connection a description of the plant which is causing so much trouble may not prove uninteresting. The station is a one story brick building situated on the line of the Wabash railroad and is divided by a brick wall into two rooms of unequal size; the smaller, on the side toward the tracks, is the boiler room, the larger contains the engines and dynamos.

Horizontal tubular boilers from the works of the Springfield Boiler and Manufacturing Co. are used, and are arranged in two batteries of three boilers each; a separate iron stack is provided for each battery. Two feed water heaters and two Aetna pumps are placed between the batteries. The steam piping is so arranged that any boiler or combination of boilers may supply steam for any engine or number of engines. About half a car of slack coal costing $6 per car is consumed every day, and since fuel is shoveled from cars directly into the boiler room the coal bill is exceedingly low.

In the engine room are five 150 H. P. Buckeye engines; these engines are single cylinder, non-condensing, automatic cut-off, running 160 R. P. M. Three of them are belted to six 80-light Standard arc dynamos, and the remaining two are belted to two Standard 2,000 volt alternators. These alternators are separately excited, have external stationary armature and revolving fields, and are capable of supplying 1,800 16 C. P. lamps.

The leads from the machines to the switchboard pass under the floor, through holes in the joists protected by glass floor insulators, and are accessible from a trench.

The switchboard is built of two marble panels, one for incandescent apparatus and one for arc. The incandescent lighting is divided between two circuits, and a Standard ammeter is located in each circuit. Two voltmeters, two switchboard transformers, two rheostats for the exciters, one ground detector, and the necessary switches, all of the Standard Co.'s manufacture, are also used on the incandescent panel. Six Standard ammeters, and the necessary plugs and connections for six circuits fill up the arc panel. Behind the switchboard proper is another board carrying the lightning arresters. From the switchboard the wires are led to a wiring tower on the roof.

THE NEW CHICAGO MUNICIPAL ARC LIGHTING PLANT.

THE new arc light station installed by the city of Chicago has been started up. The station is located on the West Side at the intersection of Blue Island Ave. and Halsted St. The new station was built to take the place of the present city plant which is located on Throop St., between Harrison and Van Buren Sts.

The new plant will supply electric light for that portion of the city west of the river and between Kinzie and Sixteenth Sts. In this large territory there is at present installed 100 miles of wire and 500 arc lights. Extensions of the lighting system, however, are being constantly made, and the new plant will start with a capacity in machinery of over double the present number of lights. When all the space provided is occupied, this great arc light station will have a capacity of 3,000 arc lights and will be the largest in the United States.

The building is of red brick, with ornamental fronts both on Halsted street and Blue Island avenue. It is fifty feet wide and 208 feet long. The boiler room, fifty by forty feet, contains two Heine water-tube boilers of 600 horse-power each, with room provided for a third 600 horse-power boiler. Illinois block coal will be used, and will be delivered in barrows from the shed north of the building. No smoke-consuming device is used, as reliance is placed upon the great draft obtainable on account of the excellent stack. The boilers are tested to carry 150 pounds of steam.

The two engines are of a new type built by Rankin & Fritsch of St. Louis. They are upright compound condensing engines and run at 150 revolutions a minute. The high pressure cylinder is 20 inches in diameter and the low pressure 40 inches; the stroke is 28 inches. These engines are rated by the makers at 600 horse power. They are provided with a new type of Corliss valve without the usual dash pots. The belts connecting these engines to the shafting are 56 inches wide and 100 feet long. The shafting is so arranged that either engine will run the entire plant.

The most novel feature of the plant is the governing of the engines. For this purpose a small Worthington pump and a tank of water are specially provided. The water pressure from the pump is checked by a valve which is operated by an ordinary Porter-Allen ball governor run from the main shaft. After going through the valve the water raises or lowers a small hydraulic ram which in turn operates the link motion and varies the cut-off in the usual manner. The addition of the hydraulic feature is claimed to secure a much finer adjustment and quicker response than is ordinarily obtained by a mechanical governor. At a recent test the variation in load of 200 arc lights did not cause a change of one revolution per minute in the speed of the engine.

The present plant only occupies a little over one-half of the new station. There is plenty of room for the extensions which it is intended to make. The two engines now in operation will be powerful enough to work nearly as much more as they are now doing. The shafting, pulleys, and belt tighteners were supplied by the Hill Clutch Works of Cleveland.

The plant was started on the evening of October 9th and has been running since without a hitch. The erection of the plant was under the supervision of Mr. D. M. Hyland and Mr. Frank B. Flynn, chief engineer.

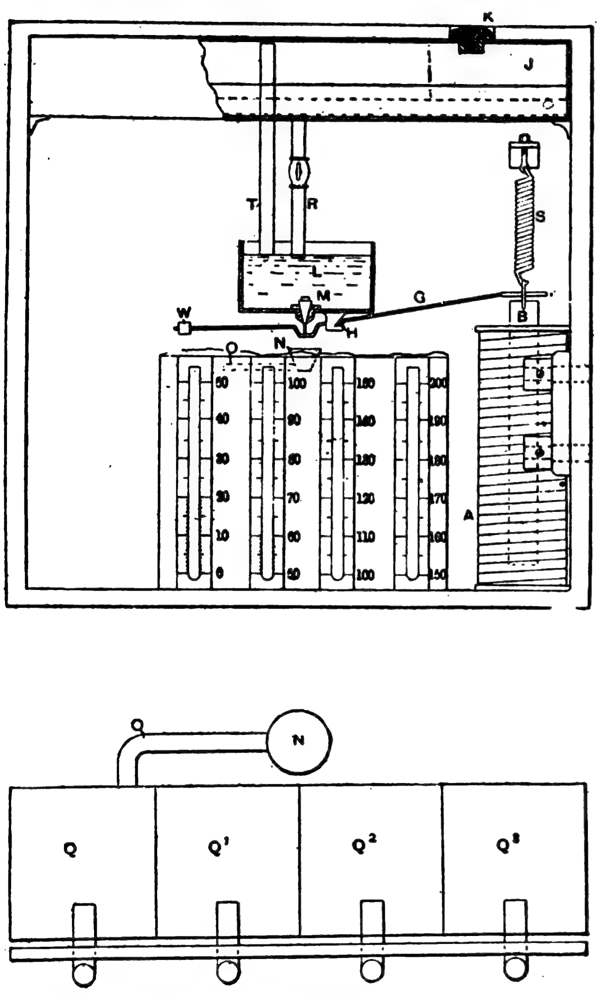
WANTS ONE A DAY.

"The Data Sheets are all right, provided it does not take a life time to accumulate a set, which it will very nearly do at the rate of four every three or four weeks. Cannot you make your advertisers see that it would pay them to get their ads. permanently kept, even though they had to pay a little extra for it to enable you to print them that way?" Henry Hess, Hamilton, Ohio.

THE COLLINSON AMPERE-HOUR METER.

The problem of a cheap yet efficient ampere-hour meter, for use in electric supply systems, has been attacked by Mr. P. Collinson, for some years the chief engineer at the Morecambe station described on page 422. The accompanying illustrations depict the instrument which is the outcome of his researches. Mr. Collinson has adopted a principle of action in his meter with which many before him have tried and failed, and it will be a highly creditable result, if he succeeds in making the instrument a commercial success. That a cheap meter is a great desideratum it goes without saying; and we understand that Mr. Collinson intends to supply his for less than $15. The principle to which we have just referred, is the measurement of electric quantity in terms of the weight or volume of a liquid permitted to pass through a throttled passage, the amount of constriction depending upon the electric current.

Fig. 1 represents a vertical section of a small meter, designed



FIGS. 1 AND 2.—THE COLLINSON ELECTRIC METER.

for a range of current of from 0.3 to 5.0 amperes, at an electric pressure of 115 volts. Fig. 2 shows a plan of the liquid storing tanks. A solenoid A (Fig. 1), in the circuit of the current to be measured, has within it a soft-iron core, B, suspended by a link from the coil spring S. In the link, and free to move vertically, is the soft-iron armature F, attached to the end of the lever G, which is suspended at the fulcrum H. Normal equilibrium is obtained by the counterpoise W. There is an air-tight storage tank, J, with a filling hole and screwed cap at K. The open cistern, L, is fitted at the bottom with an outlet valve at M, below which there is a funnel, N, connected by a pipe, O, to the first of a series of tanks, Q (shown in plan in Fig. 2), for collecting and storing the liquid. The reservoir tank, J, is provided with two tubes, R and T, for maintaining a constant level of liquid in the cistern L.

The action of the minimum current (0.3 ampere), though not sufficient to cause movement of the core B, yet magnetizes it, and causes the armature F to be drawn down, thus slightly depressing the lever G, and opening to a small extent the orifice, by which a slight discharge of liquid takes place. An increase of current causes the core B to be drawn into the solenoid, and thereby opens the valve M wider, allowing a greater escape of liquid in proportion to the current. The series of storing tanks are arranged that each will overflow into the next; and the level of the liquid in each is indicated on a gauge. The scales behind the guages are graduated to read in Board of Trade units. The particular meter shown is designed to register at the rate of 600 watts. Meters ranging to 50 amperes are contained in wooden cases measuring 12 in. x 12 in. x 6 in.; and it is claimed they will run for six months without attention.

LIGHTING GERMAN POSTAL CARS BY ELECTRICITY.

At the close of 1893 there were in the Royal Post District, Germany, 1,578 railroad post-cars, besides 906 cars hired from the railroad companies, in all 2,484 vehicles. The introduction of electric lighting in all these cars was a matter of considerable importance. The method principally considered seems to have been the storage battery system. After some experiments a form of accumulator was determined upon, which, after feeding eight 12 c. p. lamps for 24 hours, in all 192 lamp hours, fell, in potential, from 32 volt to 30 volts only. From 8 to 11 of these lamps took the place of from 11 to 14 gas lamps, and at the end of 1894 a total of 405 post cars had been fitted with electric lights and 204 more ordered to be so fitted. The batteries contained 16 cells, with a gross weight of 475 lbs. The average charge and discharge current was six amperes, the capacity of a battery 120 ampere hours. The first cost of these batteries was $115 each. Each group of four glass cells is contained in a wooden box, the space between the cells and the box being filled with a combination of paraffine, asphalt, etc. Sixteen cells form a battery. No short circuiting has occurred. Glow lamps of the Sirius type have proven the best. At 30 volts they give 12 c. p., and their average life is 211 hours each. These lamps cost about 25 cents each. Including the battery the cost for each car is about $200, which is just about what the gas installation costs. This is for a car about 39 ft. long. For a car 47 ft. long the electric installation costs a little less than the gas and is in this case 1,210 lbs. less in weight. The saving, which has been estimated by Mr. Pohl, from whose article upon the subject this note is abstracted, is about 21 per cent. over the use of gas.—*Railroad Gazette.*

ELECTRIC FOUNTAIN FOR TENNESSEE EXPOSITION.

The fountains at the Tennessee Centennial Exposition will be made special features. Four of them have already been located. One will be in front of the Agricultural Building, another, designed by Miss Yandell, the Louisville sculptor, will stand near the Commerce Building, and a third will be in the small lake. The electric fountain is designed to throw mazes of colored water high in the air from an island in the middle of the large lake. Others will be determined upon as the work progresses.

STORAGE BATTERY PLANT IN MR. C. T. YERKES' NEW YORK HOUSE.

THE Electric Storage Battery Company has closed a contract for a complete electric lighting plant for the New York residence of Mr. Charles T. Yerkes. The plant consists of an Otto gas engine, capable of giving 85 actual horse-power. This engine is belted to a 30 K. W. Siemens & Halske shunt wound dynamo, also a four-pole booster of 7½ K. W.

The storage battery consists of 60 cells of type 25-G in lead linep tanks. These cells have a capacity of 2,500 ampere hours at a ten hour discharge rate, the maximum discharge rate being 500 amperes for four hours. Mr. Yerkes' residence, at 68th street and Fifth avenue, New York City, is wired for about 1,200 16 C. P. lamps, and has besides an electric passenger elevator and several electric motors for ventilating, pumping and other purposes. This, we believe, will be the largest storage battery plant for private house use in this country.

200 VOLT LAMPS IN ENGLAND.

A well informed correspondent in England writes us: "A good deal of interest is being taken in 200 volt lamps, and I understand that in all new installations on the St Pancras mains, these lamps are to be used."

LIKE OLIVER, CALLS FOR MORE.

"Your 'Data Sheets' idea is a good thing—push it along. For 10 years I have collected data of all kinds, and now when I want to refer to it I am obliged to look over several imperfectly catalogued books, and it is 'dollars to doughnuts' that I cannot find what I want without much labor and time. Like Micawber, I have waited patiently for 'something to turn up' in the same line that is better than mine, and now like Oliver Twist I call for 'more.' Please send me a morocco filing case." H. Bottomley, Marlborough Electric Co., Marlborough, Mass.

LETTERS TO THE EDITOR.

ELECTRO-MAGNETIC SWITCHES IN CLOSED ELECTRIC RAILWAY CONDUITS.

YOUR editorial on the subject of "Conduit Railway Optimism" and the letter of Mr. E. H. Johnson on the subject of the closed conduit electric railway system were read with great interest. The writer being an engineer for street railway construction of all classes, might mention a few points of interest, and consequently begs of you a little space for the same.

Mr. Johnson says: "* * * my training in telegraphy taught me that about the most reliable thing in the physical world was an electro-magnet, and therefore that I had in it an agent which would, beneath the earth's surface, as surely and reliably do my bidding as any that could be employed in the open." The testimony of any telegraph operator is by far the reverse; that his magnets both for relay and sounder need constant readjustment; that no adjustment can do for all the varying conditions of service in atmosphere, temperature, etc. The resistance, current and electromotive force of the line vary with the different conditions under which the system is used. If the current be too strong the magnet core will often have enough residual charge left after the circuit be broken to hold down the armature, and if it be too weak, the armature will not be properly attracted and the desired contact will necessarily be too weak. Hence the constant tests and adjustments that an operator invariably has to make.

If electro-magnets are going to give all this trouble in telegraphy, how much more will they give when subjected to the vastly more exacting service of a closed conduit electric railway with much traffic? These difficulties will not only be more than proportional to the traffic, but very much enhanced by other factors pointed out below.

Mr. Johnson used a working sectional conductor charged by magnets placed in boxes between the rails and from this conductor current was taken by means of a metallic sliding contact brush. Unless this brush collector had a clean and strong contact the magnet would not act; to obtain such a contact in any dirty street, the pressure of the brush against the conductor would have to be such as to make much friction; this would cause great wear and tear together with heat; this heat would not only soften the contact surface but it would consequently increase the wear just spoken of and the resistance of the contact; this in turn would change the conditions for which the magnet was adjusted and it would refuse to act, and a magnet designed for these altered conditions would be useless unless heat were applied to the contact brush before the car (immediately before) was put into service, or the batteries on the car depended upon until the contact brush became heated by friction. Such difficulties will be greater in proportion to the traffic.

Electromagnetic switching devices have been tried and abandoned by many inventors and their testimony has invariably been, in the words of Mr. Albert Stetson (before the A. I. Electrical Engineers, Dec. 20, 1893). "—they have proved a constant source of trouble. * * * All of us who have had any experience with electro magnetic switching devices know that the less number we have of them the better they work."

The conditions under which Mr. Johnson made his test in a vacant lot on Sixty-ninth Street were in no way comparable to to those out on a dirty street. The dirt had little chance to collect on his track enough to hurt his contact, and what little dirt could collect there was (owing partly to the slope on which his track was laid, in a lot clean compared with many a street on which a car line must operate) easily washed off by a little rain. Again he had no snow except what could be easily and quickly removed.

Mr. Johnson says further that a "higher voltage can be used underground than overhead." Why then did he use only 300 volts, instead of the customary voltage between 500 and 700 now used on overhead systems? In a dirty street such a system as he exhibited would with "higher voltage" than is "used overhead" have enough trouble with what Mr. Stetson, above quoted, called the "continuous grounding of the live wire" on a bad day, to so increase the load as to very much add to the drop in voltage from the dynamo to the car. The contact made by the magnets would thus become very quickly too weak to be reliable. His storage batteries on the car would help him for a little while in such an event, but the extra drain of their charge would soon reduce their potential too low to effectively operate the magnets and propel the car efficiently.

The success of the closed conduit system depends upon finding an effective and safe mechanical switching device; unless this can be found there is no hope for it. I have in mind several street car companies who have taken the overhead trolley, open conduit or even storage battery, instead of the magnetically switched surface system simply for these reasons.

If an electromagnet is the "most reliable thing in the physical world" why is it not used on each individual car as a cut-out instead of a fuse? Its use for this purpose has often been seriously discussed. If it gives too much trouble for such service, what chance would it have to meet the exacting conditions already spoken of? Any street car man knows that these statements are mild compared with facts.

JAMES H. BATES.

NEW YORK, Oct. 18, 1895.

THE ACME BATTERY IN TRACTION WORK.

IN your issue of September 18, there appeared a communication from Mr. Maurice Barnett which purported to be an article on the general subject of storage battery traction and as giving an affirmative answer to the question now so eagerly discussed by railroad men, Can we run economically with a storage battery? His letter of October 9, however, makes it plain that he merely wished to give prominence to one form of battery, and to depreciate every other. All this is like the old time when there used to be two kinds of electricity, the Edison current and the death current. The other fellow sells the death current.

If Mr. Barnett objects to having his name quoted in your issue of October 2nd, I will say that I am sorry I used his name at all, and would not have done so but for one reason. In furnishing the data from which the objectionable article was compiled, I thought that it would be better to mention Mr. Barnett's article, inasmuch as it is accessible to all your readers, whereas, that of M. Sarcia, from which Mr. Barnett obtained his information, is not.

Mr. Barnett's article is open to the criticism that it is written so that wrong inferences may be drawn by the reader. It is a sort of expurgated edition of M. Sarcia's paper. Mr. Barnett's article not only leaves it to be inferred, but positively states that the Paris record was made with the "Chloride" battery. This is a half truth which is in effect an untruth. To be sure "Chloride" negatives were used, and if the friends of the "Chloride" battery can extract any glory out of that fact they are welcome to it. The crucial test of a battery, however, is the endurance of the positives, and those who will take the trouble to read M. Sarcia's paper will there find that the *"Chloride" positives were discarded.* For some new discovery? *No, for one of the early forms given by Faure.* When the paste falls out they poke it back again. Just think of it, and then consider if there is any great stretch of imagination in supposing that if such a battery can make a commercially successful record, a battery of the Planté type may possibly succeed too.

Those who are exploiting the "Acme Storage Battery" desire to steal no one's thunder, and I did not imagine that anyone would put the construction upon the Acme article that Mr. Barnett has.

But more especially we did not wish to claim credit of that part of the Paris record which refers to the paste falling out and being poked back again. We do not use paste.

TOWNSEND WOLCOTT.

Oct. 19, 1895.

THE NECESSITY FOR STANDARDIZING LAMP SOCKETS.

YOUR movement in this direction has evidently struck the key-note of a real grievance.

The grievance being manifest—what is the remedy? That is now the question.

The letters you have so far received each indicate a preference for one or other of the present types of socket—one writer preferring this type, the other that—but none give *reasons* for their preference. Would it not be well, therefore, at this stage, to have an interchange of views as to what each writer considers are the points of recommendation peculiar to the type he prefers—thus the question will be, how may those good points be embodied in one and the same socket?

In my former communication I said of the Thomson-Houston base that it favored a "simpler, safer and less expensive" form of socket. I now desire to substantiate that statement by reasons.

It is *simpler* because of its fewer parts and because no insulation is needed to guard against a short circuit through the metal forming its outer case.

It is *safer, electrically*, because, in handling, there is little or no risk of an accidental contact between an electrode and the case of the socket (both electrodes being internally situated within the circumference of the porcelain block to which they are affixed) while, in regard to the other types, it is this liability to accidental contact which makes them faulty in this respect.

It is *safer, mechanically*, than the screw-shell of the Edison type because the latter, having a very coarsely pitched thread, is liable to work loose by vibration, whereas, the contact nipple in the centre of the Thomson-Houston socket is *finely threaded* and therefore much safer in this respect.

It is *less expensive*, because of its fewer and simpler parts and also, by reason of the arrangement of its electrodes, it admits of reduced proportions in every respect.

It is objected that this form of socket involves a more expensive *base*.

But this question, I apprehend, is not to be determined by types *as at present embodied in practical manufacture* but rather by the *possibilities inherent in each case*—and, viewed from this standpoint, there does not appear to be, and really *is* not, any valid reason why a base adapted to a Thomson-Houston type of socket *should* cost as much as it now does, or, indeed, any more than for the other types.

ALFRED SWAN.

NEW YORK CITY, Oct. 12, 1895.

DIRE EFFECT OF NOT CONFORMING TO THE PATENT OFFICE RULE.

Since my publication of information about the new time limit, in the daily papers and engineering periodicals, some inventors have called upon me and alleged that their attorneys advised them that I was wrong, and that the new rule was reversed. Those who paid no attention to the new rule are now receiving the following notice from the Patent Office.

"Under present rule 65, this application has been re-examined. The claims are again and finally rejected on the references of record."

This means that the same claims can be further prosecuted only by appeal; whereas, if they had been acted upon by the attorney within six months after the first rejection, an argument could have been filed in behalf of patentability of the invention, without depositing the fee for appeal.

In brief, the new rule requires action by the attorney within six months after any decision of the U. S. Patent Office, instead of two years as formerly. The rule went into effect on April 15, 1895, and affected pending cases as rejected on that date, and therefore the first limiting date was October 15.

EDWARD P. THOMPSON.

TEMPLE COURT, NEW YORK CITY, October 22, 1895.

TELEGRAPH WIRES IN THE HOOSAC TUNNEL.

WILL some of your readers inform me through the columns of paper, if telegraph wires are run through the Hoosac Tunnel and if not, what the reason is. In an article appearing recently in a daily paper, the statement was made that it was impossible to communicate by wires strung through the tunnel.

H. T. C.

TROY, N. Y., Oct. 11, 1895.

TELEPHONY AND TELEGRAPHY.

A WESTERN TELEPHONE CONSTRUCTION CO. EXCHANGE FOR ELIZABETH, N. J.

Last week the contract for the equipment of the new opposition telephone exchange at Elizabeth, N. J., was awarded to the Western Telephone Construction Co., who will install a 300 subscriber plant, including switchboards, subscribers' instruments, etc. The contract was secured by Mr. J. E. Keelyn president of the Company, in the face of strong competition, and constitutes the first work of the kind to be carried out by the Company in the East.

TELEPHONE REFORM IN FRANCE.

Telephonic communication will shortly be conducted under more favorable conditions in France. According to *L'Eclairage Electrique* of September 14, decrees have just been signed by the Minister of Posts and Telegraphs which will come into force on January 1, 1896, and which will remove from the Government regulations a number of provisions which hitherto served to harass the public and restrict the use of the telephone, to the detriment not only of the subscribers but of the finances of the State. The charge for conversations exchanged between two systems within a radius of 25 kilometers (16 miles), starting either from the house of a subscriber or a telephone office, will be reduced from 50 to 35 centimes. Similarly, the rate for a conversation over a single system, which in Paris and a great number of towns costs 50 centimes, is to be reduced to 25 centimes. The duration of a conversation will be limited to three minutes, statistics having shown that this was the average period at the higher price. The extension of the radius of communication at the reduced tariff (25 centimes) will, moreover, entail the suppression of the subsidiary systems, the existence of which has been the cause of so much complaint. These will henceforth cease to exist, both in the environs of Paris and in the departments, and all systems will be placed on the same basis.

DANISH TELEPHONE BOOTHS.

A company has been formed in Copenhagen with a preliminary capital of 100,000 crowns, to erect in all the public squares of that city telephone-kiosks, in which, besides the use of the telephone, the citizens will find the daily papers, be able to write letters, have their boots blackened, receive messages, etc.

NEW YORK LAWS AFFECTING TELEGRAPHY AND TELEPHONY.

According to legislation passed by the New York Legislature during its 118th session, and going into effect in September, railroads in New York State may no longer employ as a telegraph operator a person who is under eighteen years of age, or who has had less than one year's experience in telegraphing, to receive or dispatch train orders. To do so is a misdemeanor.

The same protection hitherto thrown around the sacredness of a telegraphic message is extended to a telephonic communication. The penalty that awaits the employee who divulges the contents of a message by telephone to an unauthorized party is a fine of $1,000 and six months in the penitentiary.

The use of the telegraph wires by the green goods gang moved the Legislature to declare it the duty of any corporation or employee thereof having knowledge of an unlawful traffic being carried on, aided or abetted by the use of the wires, to aid the officers of the law in preventing such traffic and to assist in the identification of persons carrying on any illicit enterprise. There is no penalty attached to the failure to do so, and the green goods gang may therefore continue to use the wires, and telegraph operators will continue to make a few extra dollars each month.

INCREASE OF WESTERN UNION FACILITIES IN THE NORTH-WEST.

Mr. R. C. Clowry, vice-president of the Western Union Telegraph Company, who has been on a tour of inspection throughout the Northwest and the Twin Cities, recommends that three more quadruplex lines of copper wire be laid between Minneapolis and Chicago, as his investigations developed the fact that the present facilities are inadequate to care for all the business that they are compelled to do.

UNDERGROUND WORK FOR COLUMBUS, O.

THE Central Union Telephone Co. is to put its telephone wires underground in Columbus, O. Messrs. Jackson & Wilson. of Chicago, are doing the work. Tile conduit is to be used. The line will be about one mile in length, with from 16 to 30 ducts in the trench.

A STANDARD ACCOUNTING WANTED IN WISCONSIN.

A special dispatch from Milwaukee of Oct. 23 says: The Wisconsin stockholders of the Standard Telephone Company, which was organized with a capital of $21,000,000, have demanded an accounting of the money subscribed by them. Several letters, it is alleged, have been written to the officers, and if an accounting is not soon forthcoming, suit for the recovery of the money is to be brought. The stockholders believe their stock is of little value.

BIKE BOYS WIN THEIR STRIKE.

When a Western Union messenger, was discharged recently at Detroit for refusing to deliver a message outside the two-mile circle without being provided with car fare, he became a martyr to the cause of his fellows, who have felt that the additional 10 cents should be paid them as formerly when obliged to go outside the two-mile limit. Since the boys adopted the use of wheels the dime has been withheld, but as the bikes are their own, they naturally claim this is unjust. A strike resulted and the messenger room in the telegraph building was filled for three hours with carriers who wouldn't carry. Recognizing the gravity of the situation and the peril to the interests of the Western Union, the company capitulated, reinstating the discharged messenger and granting the car fare. Then the messengers darted forth in glee with three hours' accumulation of telegrams.

A CABLE UP THE AMAZON.

The new cable up the Amazon, running westerly from Para to Manaos, a distance of 1,200 miles, will aid in the opening up of a vast area of the valley of the greatest of South American rivers. Though the cable is to run but half way across northern Brazil, or to the point where the Rio Negro unites with the Amazon at Manaos, it will go as far as it can yet be made useful; for there is hardly any cultivated ground between the Rio Negro and the western boundary of the country. The Indian element yet predominates along the whole length of the valley; but commerce is increasing as the resources of the region are developed. The yellow fever, from which the seaboard cities are hardly ever free, does not often go far inland. There are already about 12,000 miles of telegraph line in Brazil. The commerce of the Amazon justifies the construction of the new cable line which is to be laid by the Siemenses.

THE HOME TELEPHONE CO. OF MOBILE, ALA.

THE Home Telephone Co., of Mobile, Ala., under the energetic management of Mr. Paul Minnis, have one section of their board up and with nearly 300 instruments connected. The second and third sections will be in place shortly. The company's subscribers' list now numbers 700 and is growing daily. The transmitter, line, etc., are all placed on the primary, without induction coils, with the batteries all centralized at the exchange and a common copper return not grounded. Mr. Minnis informs us that with this arrangement he is obtaining better results than he has ever found in the highest class old style exchanges.

LOCAL TELEPHONE WORK NOT A BONANZA.

IN view of the fact that a new telephone company is being talked of as among the probabilities, the Wilkesbarre, Pa., *Record* presents an interview with an official of the Central Pennsylvania Telephone Co., which gives some interesting facts, and the main points of which are undeniably true.

"The promoters of cheap telephone schemes are telling the people of the millions that have been made and of the millions that are still to be made in the telephone business, and showing on paper how easily and cheaply the thing can be done.

"The facts are that the few individuals who owned the Bell patents and controlled the entire business have become rich, while the local companies have not made money.

"The stockholders of the local company (the C. P. T. Co.) have not received more than 6 per cent. at any time, and for two years prior to April 1, 1894, did not get a dollar, directly or indirectly. Since then only 4 per cent. per annum has been paid. In the past two years we have borrowed and put into betterments $128,000.

"This does not look much like a gold mine. Careful business men will think twice before putting their names on the papers of cheap telephone promoters. They will know how much credence to give the reckless statements that, the telephone patents have expired, that they propose to connect with the Long Distance Telephone System, etc., etc. They will know that these gentlemen have a lot of cheap poles or other cheap material to unload upon them at good prices, and that while the promoters may come out ahead, the honest investor and subscriber generally comes to grief.

"All telephone users who have had experience with the experimental stages of the business will be very slow either to go back to cheap service or to put any money into cheap telephone schemes, no matter how glitteringly such schemes may be presented to them.

"Our subscribers want the best possible service at the lowest possible cost, and that is just what we mean to give them."

THE TELEGRAPH IN CANADA.[1]

BY CHARLES P. DWIGHT.

The first commercial telegraph line erected in this country was in the year 1847, between Toronto, Hamilton, St. Catharines and Niagara Falls; connecting at the latter point with a line through to Buffalo, owned by one David Kissock. In the same year, 1847, was organized the Montreal Telegraph Company, with a capital of $60,000. This Company immediately proceeded to construct a line from Quebec to Toronto, and soon afterwards purchased the line erected by the Toronto, Hamilton, St. Catharines & Niagara Falls Company. At the close of the year 1847 the Montreal Company had in operation 540 miles of wire, with 9 offices, 35 employees, and had sent in all 33,000 messages.

The author then describes the various companies formed down to the year 1868. In that year was organized the Dominion Telegraph Company, which had soon built lines embracing all the important points between Buffalo, Detroit and Quebec, and whose opposition became more lively as time went on. Rates were reduced, and the outcome promised disaster for all concerned. When in 1881, therefore, a proposition was made for the consolidation of these conflicting interests, under lease, by the Great North Western Telegraph Company, considerable satisfaction at the prospect was expressed by all concerned, and a deal on these lines was accordingly put through, and is in operation to day. The combined mileage of the two Companies at the present time, as operated by the Great North Western Tel. Co. at the present time, is 18,000 miles of poles, and 40,000 miles of wire, with some 1,800 offices throughout Ontario, Quebec, New Brunswick, Manitoba and Northern New York State.

By means of this amalgamation the telegraph business of the country was for a time almost entirely in the hands of the Great North Western Telegraph Company. In every city and town where two offices had previously been maintained the wires were all taken into one, and sweeping reductions in expenses consequent upon such a move were at once inaugurated. The monopoly thus brought about was not destined to last long, however, and almost immediately afterwards the Canada Mutual Telegraph Co. was organized, and constructed lines between Niagara Falls and Toronto, Montreal and the boundary line, and Montreal, Coteau and Ottawa. Some three or four years after the amalgamation had been effected, the Canadian Pacific Railway Co. had also commenced the construction of telegraph lines along the route of their road, and between many of the principal cities and towns of the Dominion, and in September, 1886, had opened 336 commercial telegraph offices throughout Ontario, Quebec, Manitoba and the North West Territories. Since that time they have been constantly adding to their plant, and at the present time have somewhere in the neighborhood of 25,000 miles of wire in operation, and 800 offices.

In certain remote localities along the St. Lawrence and in the North West territories, where private companies would hardly be justified in extending their lines, the Dominion Government have in operation at the present time somewhere in the neighborhood of 3,000 miles of wire.

The total amount of capital invested in Canadian telegraphs may be roughly fixed at between six and seven million dollars, and the total wire mileage at somewhere in the neighborhood of 75,000.

In respect to population it can truthfully be said that no country in the world enjoys a more extensive system of telegraphs than Canada. Scarcely a town or hamlet in the whole country but has connection by this means with the outside world. Hundreds of offices are maintained throughout the country in small-of-the-way places, where the actual business is but trifling, and where the lines in reality prove much more a matter of convenience to the public than profit to the telegraph companies.

The following comparative table, showing the number of inhabitants per each telegraph office, will indicate more clearly the position of Canada in this respect.

Country.	No. of Inhabitants to each Telegraph Office.
Great Britain	6,417
Switzerland	2,556
Holland	10,254
France	7,719
Germany	4,510
United States	5,625
Canada	2,320

In respect to rates, too, no country enjoys a cheaper schedule than Canada; distances and other conditions fairly taken into account. The maximum charge between offices in Ontario, Quebec and New Brunswick is 25 cents, and for this sum a message can be transmitted over twelve hundred miles of wire.

1. Abstract of a paper read before the Canadian Electrical Association, Ottawa, 1895.

TELEPHONE NOTES.

ANTWERP, N. Y.—The International Telegraph and Telephone Company have completed their telephone line to Antwerp.

ALTOONA, PA.—The Altoona Phoenix Telephone Company has been formed; capital, $15,000.

ANDERSON, IND.—The Pana Telephone Company proposes to build exchanges at Anderson, Tipton, Kokomo, Logansport, Summitville and Alexandria, connecting them with Elwood.

SCHOOLCRAFT, MICH.—The Southern Michigan Telephone Co. has a franchise at Schoolcraft, and will put in instruments there at $8 and $12 a year.

NILES, MICH.—The Niles Telephone Company will put in magneto telephones in order to compete with the Bell Company, who are going to put in a new system for the service of the city.

WINONA, MINN.—The Winona Telephone Company will in a short time build a line to the towns of Witoka, Dakota, Dresbach and Pickwick.

ALBANY, GA.—The telephone line is complete from Tifton to Sylvester, and will be run on into Albany just as soon as arrangements can be perfected with the Bell Telephone Company whereby the new line can be run into their office.

SUPERIOR, MINN.—The Superior Telephone Co., a new enterprise, has been granted a franchise for 25 years by the Superior council. John Goodnow, of Minneapolis, will be general manager of the new company.

PARKSTON, S. D.—The county commissioners have granted G. W. Williams, of Olivet, a franchise to construct 100 miles of telephone line in this county, connecting the various towns with the county seat. A line will in all probability be built to this place.

ATLANTIC CITY, N. J.—At an adjourned meeting of City Council the ordinance "granting permission to the Atlantic City Telephone Company to construct a system of wires, cables, pipes and conduits and erect poles for all purposes" was passed by a vote of ten to five, and afterwards signed by the Mayor.

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CONTENTS.

SOCIALISTIC LIGHTING AND RAILWAY STATISTICS.

AFTER making a very superficial investigation of city lighting plants, the special committee of the Boston Common Council has filed a report, which is just about what might have been expected. The conclusion of the committee based on its own "data," is that an electric-light plant could be established by the city at a cost, including land and buildings, of not over $250 an arc light. On this extraordinary estimate the cost to the city of a 3,000-arc plant would be $750,000. The interest on the investment, a fair charge for depreciation and well-paid labor, would, in the opinion of the committee, make the total cost not over $75 an arc, or a net saving to the city of at least $125,000 a year.

These are very pretty figures but they are as wild and foolish as can well be, and betray the utter inability of municipal plant advocates to do justice to those who have invested their capital in building up the new industry of electric lighting. The Boston Electric Light Co. has an investment of about $2,500,000, and is paying 8 per cent. dividends on its stock. It receives only $139 per light per annum, and has given a good service. Yet this whole investment is to be wasted and confiscated, if the municipal scheme carries, although the law of Massachusetts stands like a lion in the path against such robbery, and would probably be invoked were the scheme to be pushed.

Looking into the report, we note the usual fallacies and inaccuracies. The price paid in Boston is, of course, compared with that paid in other cities, without mention of the fact that the candlepower elsewhere is less, or the coal cheaper, or the water supply freer, or the cost of real estate and labor much lower. It would never do for a municipal plant advocate to mention these little details. But in quoting figures in the large, why, we would like to know, was Chicago overlooked, where, according to Prof. W. J. Meyers (writing without prejudice in the *Popular Science Quarterly*) the cost per light to the city, when served from the municipal plant, has been $167 per light per year? An ugly fact like that is not needed by Boston municipal plant advocates, however, any more than the fact that the city would lose a large part of the $21,000 now paid in State and city taxes by the electric light company.

When one turns to the advocacy of municipal ownership of street railways, the same palpable weakness of the figures prejudices the cause. Prof. E. W. Bemis is being discussed because he had to leave Chicago University for preaching the "socialistic truths" of municipal ownership; but if what he taught in college is as far from the truth as what he writes outside, his dismissal was a good thing in the cause of truth. This month, for example, we note this from his pen:—"I suppose the success of our own municipal street car line over the Brooklyn Bridge is known to all. What private company would voluntarily reduce fares as this public company has done?" Can it be possible that Prof. Bemis knows the facts in regard to the Brooklyn Bridge? If he does, he could not have written the above. If he does not, where is his honesty and accuracy as a teacher? The Brooklyn Bridge with its 3-cent fare for about a mile, charges more than any private company we know of in the Union. As for the service, it is a disgrace to civilization, and every change made by the governing board only adds to the distress and incon-

venience and delay inflicted on the passengers. If there is one institution in this part of the world that exacts an outrageous tariff and gives a wretched return, it is the municipal Brooklyn Bridge car line. And yet a public teacher like Prof. Bemis, who prides himself on martyrdom for the truth, talks about its success being known to everybody and about its voluntary generosity in reducing fares!

LIGHTING CONSOLIDATIONS IN PHILADELPHIA.

One of the most important consolidations ever effected in the field of local electric lighting is that accomplished last week in Philadelphia, when the new Pennsylvania Light, Heat and Power Co. absorbed the Edison Electric Light Co. It is understood that this is part of a programme of absorption which includes the following properties:

	Capital pd.	Par.	Div. rate.
Edison	$1,847,222	$100	8 per cent.
Brush	1,000,000	100	6 per cent.
Suburban	800,000	10	6 per cent.
Diamond	250,000	10	not stated.
Manufact'rs	203,560	10	5 per cent.
Powelton	450,000	10	8 per cent.
Columbia	66,000	100	not stated.

What gives special importance to this consolidation is that back of it lies an intention to utilize the storage battery extensively as a station adjunct, the masterly hand and mind of Mr. W. W. Gibbs being devoted to the realization of that entirely feasible and desirable project. We believe that even greater economies will result from use of the battery than from the welding together of so many managements in one. When the Boston Edison Co. can run its whole system off its batteries for 15 hours at a time, the battery has certainly "arrived." Besides, there is a great probability that Philadelphia may be the scene of some notable economies in fuel and the production of current. Altogether, this "deal" is one of the most interesting of recent years.

GAS AND ELECTRICITY.

Gas has always been looked upon as the hereditary enemy of electricity, or, to put it more accurately, electricity has always been looked upon, at least by the gas people, as the enemy of gas. The events of the last few years, however, have shown that gas, far from being the enemy of electricity, can be made its best friend. It used to be a favorite illustration for lecturers, and advocates of electric lighting in the early days, of the art to figure out how, by employing a given quantity of gas in a gas engine driving a dynamo, more light could be obtained than if the gas were burned directly in open burners, in the ordinary way. It took a long time for this idea to take root in the minds of central station operators, but the advances made in the last few years give every indication that we shall see an extensive use made of this method of station operation. The description we give, in this issue, of a plant of this kind at Morecambe, England, is interesting in more than one way, but the low rate of cost of fuel per kilowatt hour metered out of the station, will not fail to impress itself on those who keep an accurate record of the cost of station operation. The cost for fuel, 18 shillings ($4.40) per ton, is higher than the cost for a similar item in most stations in this country; yet, notwithstanding, the cost of the kilowatt hour delivered to the mains was only one halfpenny, or one cent. This figure is better, by more than 20 per cent., than the best figure for the same item shown by any of the London electric light companies, all of which are operated by steam engines of one form or another. If we take into consideration the additional fact that the Morecambe station has an output of only a small fraction of the best of the London companies above alluded to, the showing in favor of gas becomes still more favorable.

We are glad to note that the subject has been taken up in this country in a vigorous manner by Mr. Westinghouse, who has come out strongly as an advocate of the gas engine. The figures submitted by Mr. Westinghouse to the Directors of the Pennsylvania Railroad as to the saving in operating expenses which could be effected by the adoption of electricity, generated from gas plants distributed along the road, are highly significant, and must have made a lasting impression on the minds of Mr. Westinghouse's auditors. That the gas engine manufacturers are also alive to the situation is shown by a constant increase in the size and power of engines built by them, the largest thus far built in England reaching 500 H. P. While there will be plenty of work still for the steam engine to do, it behooves manufacturers of such engines to keep in close touch with gas engine work, for in that direction surely lies one of the largest developments in power generation for electrical distribution.

CANAL "GRAYHOUNDS."

Hearty congratulations are to be extended Messrs. Lamb and Hawley, as inventor and promoter respectively of the ingenious method adopted successfully last week for operating the Erie Canal by electricity. It will be remembered that Mr. Hawley made a previous trial with the ordinary trolley system; but the ideal plan of hauling from the bank has been adopted and we believe great results for good will ensue. The inexhaustible energy of Niagara will not only be applied to the canal, and following its lines penetrate into the interior of the State; but other canals now grassgrown or green with the slime of years will be reclaimed. We may even see a period of canal "grayhounds" furnishing cheap and very comfortable transportation for passengers; but the freight part of the question will of course be first dealt with.

COL. HAIN AS A BACK NUMBER.

If there be an improvement that is obviously desirable for the New York Elevated Railroad and the revenues of its stockholders, it is the adoption of electricity. But Col. Hain, its engineering and managerial spokesman, is so frequent in his remark that electricity is still an experiment and that "we shant see it in our lifetime," one must now take it for granted that he is a hopeless, hardshell conservative in this matter, of the class that represents the worst kind of intellectual petrifaction. It may be that the Colonel's prejudice or ignorance is assumed, for he has had the reputation through life of possessing rather more than ordinary intelligence and is not of the type that furnishes the worst instances of arrested development. Leaving this interesting little problem in fossilization for time to elucidate, it is pleasurably refreshing to find Col. Henry G. Prout, the editor of the *Railroad Gazette*, urging steam railroad men to master electricity because the railroads have got to adopt it. Col. Prout is not less a man of light and leading as an editor, than when as an engineer in Egypt he was one of Gordon's right hand men in civilizing the dark regions of interior Africa; and his attitude with regard to the agency that is so profoundly to affect the art of railroading in the years that remain of this century—to look no further—does credit alike to his foresight and his courage. His recent address to the Railway Superintendents, advocating electricity, is the index of the true situation, for if there be one fact surer than another it is that in some sections of the country, such as New England, in five or ten years, the steam locomotive will be absolutely wiped out of existence. Meantime we may timidly venture to remind Col. Hain of Abraham Lincoln's remark that only the foolish and the dead never change their opinions.

ELECTRIC TRANSPORTATION DEPARTMENT.

THE STATUS OF ELECTRICITY ON RAILROADS IN OHIO.

SINCE the electric railroad began to become so potent a factor in the traffic carrying facilities of Ohio, there has been a constant discussion as to its rights and powers under the laws governing railroads generally, and as to whether or not it comes under the authority of the State Commissioner of Railroads and Telegraphs on the same plane as other railroads. The following communication, which has been sent by Attorney General Richards to Commissioner Kirkby, throws some important light on this subject:

In your favor of the 17th ult. you state:

"Complaint has been made to this office by citizens of the State calling my attention to the condition of bridges, trestles, etc., on a line of road between Sandusky and Norwalk and asking that an inspection of the same be made. The railroad in question is operated by electricity, but carries passengers, freight and mail. I have the honor to request that you will give me a decision as to whether, in your opinion, under the statutes creating this office and defining the duties of the commissioner, this road and similar ones operating in the State, are under the jurisdiction of this office and subject to the same regulations as govern steam railroads."

In answer I beg to say that in my opinion you have authority to inspect the railroads you describe, notwithstanding the fact that they are operated by electricity. Such railways cannot properly be classed as street railways, but transporting passengers, freight and express between different parts of the State, they are railroads or railways within the proper acceptance of the term, although operated by electricity. As you are well aware electrical locomotives are now used on parts of some of the great interstate railway systems, notably in drawing the trains of the Baltimore & Ohio railroad through its great tunnel in Baltimore. The view I have taken is further confirmed by the act of the general assembly, passed May 21, 1894 (91 O. L, 397) which enacts, "that upon any railroad heretofore or hereafter constructed in this State electricity may be used as a motive power in the propulsion of cars."

MR. WESTINGHOUSE ON GAS ENGINE STATIONS FOR TRUNK LINE RAILWAYS.

WHILE on their annual tour of inspection this month the directors of the Pennsylvania Railroad, headed by President Roberts, were taken to the works of the Westinghouse Co., at Brinton near Pittsburgh, and shown the latest advances in electric railway apparatus. At that place they were addressed by Mr. Westinghouse who had on request prepared special data upon the operation of railways electrically by power stations employing gas engines. In the course of his remarks Mr. Westinghouse said:

"A strong argument heretofore used against the adoption of the electric system for main lines, has been due to the fact that the investment required to make the change would be heavy, without materially decreasing the consumption of fuel and other costs of operation, an objection which it is believed can be met by the development and use of gas engines of large sizes instead of steam engines, for the generation of the electric current."

After presenting arguments to show that the gas engine, would use but one-eighth the fuel of an ordinary locomotive to produce similar power, Mr. Westinghouse continued:

"The Pennsylvania railroad to-day, it is said, consumes about 5,000,000 tons of coal per annum on its lines east of Pittsburgh, taking, approximately, 20 loaded trains each day for its transportation, and consequently the return of 20 empty trains, and requiring for the service of the company alone, fully 3,000 cars and a proportionate number of locomotives. If this power were to be generated by gas engines, only about one-eighth, or 600,000 tons of coal per year would be required, effecting a saving of over 4,000,000 tons of coal, now costing the railway company above $5,000,000, a saving which would justify a large enough capital expenditure to cover the complete equipment of the railway.

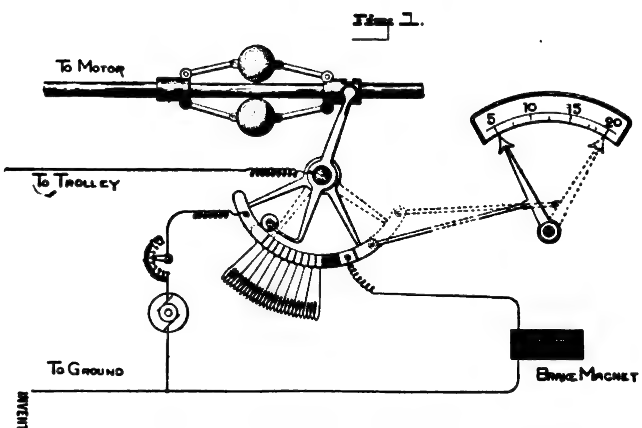
"To carry out an arrangement of this character, stations having electric generating plants with gas engines and producers, could be located at intervals of from 10 to 12 miles, so that there would always be two or three stations furnishing current for any particular part of the line.

"The electric locomotive for hauling such trains would be entirely different from the present locomotive and could obviously permit of changes in operation, for no electric locomotive need have a greater weight and capacity than needed to haul from 25 to 30 cars. It can be operated by one man and will be of such a shape that it can be conveniently used as a caboose car and for the carrying of tools and appliances for cases of emergency. Instead of putting the whole motive force in front, and thereby subjecting the road-bed, bridges and cars to excessive weights and strains, a second locomotive can be conveniently placed in the centre of long trains, thus subdividing the force applied for its propulsion, thereby reducing to convenient limits the quantity of current required for the operation of a train, though, as has already been demonstrated, electrical locomotives can be made which will have greater hauling capacity than any steam locomotive which has yet been produced.

"The electric operation of railways permits readily of a more frequent and rapid train service than is possible with steam locomotives, and it is not impracticable to attain, upon properly constructed and guarded tracks, very high speed, so that a very frequent service of very light trains between such cities as New York and Philadelphia, Baltimore and Washington could easily be provided, to the great advantage of the public and to the profit of the company undertaking such a plan of operation.

THE BRADY SPEED CONTROLLER FOR ELECTRIC CARS.

THE difficulty experienced by electric railway companies in securing careful motormen to maintain the speed of their cars within the limits prescribed by city ordinances, makes desirable some device by which the speed may be controlled independently of the motorman. A scheme of this nature has been worked out by Mr. James Brady, of Brooklyn, N. Y., who describes it in a patent recently issued to him. The method employed is clearly shown in the accompanying engraving. As will be seen, a centrifugal governor is geared to the motor or axle and controls a movable contact which is included in the motor-circuit and is adapted to throw the motor out of circuit or throw into circuit additional resistances for regulating the speed of the motor. Mr. Brady also provides a shunt-circuit including a magnet which controls a braking mechanism, the shunt-circuit being thrown into the main circuit after a certain amount of resistance has been brought into circuit or after the motor has been cut out. There are also provided three indicators, one being on the inside of the car in



BRADY SPEED CONTROLLER FOR ELECTRIC CARS.

view of the conductor and passengers and the other two being on the outside of the car, one on each side, in view of the public, for indicating the speed at which a car is being run. The several contacts of the resistances and the shunt-circuit are grouped into a movable series and means provided whereby the series of contacts can be shifted with relation to the movable contact-arm under the control of the speed-governor, so that the resistances and shunt-circuit can be brought into circuit for different rates of speed.

$70,000 SPENT IN PHILADELPHIA TROLLEY PARTIES.

The full extent of the "trolley party" infatuation and the number of persons who have engaged in it is shown by the receipts of the four companies up to Oct. 1. The amount received by the People's Traction Company is $17,000; the Philadelphia, $30,000; Electric, $20,000; and Hestonville, $3,000, or $70,000 in all. The average amount received from each participant is estimated at 10 cents, and this would show 700,000 persons who indulged in this amusement.

CHRONOGRAPH FOR STREET RAILWAYS.

The apparatus illustrated in the accompanying engravings was designed in response to the need which was felt for knowing how the cars of a system were running, by merely looking at a chart in the central office of the railway. It was thought if such an apparatus could be designed to work successfully it would greatly facilitate the operation of the road, and the experience of nearly two years has proved this to be an established fact.

The chronograph was designed and manufactured by the Emerson Electric Manufacturing Company of St. Louis, Mo., on the suggestion of Mr. Geo. Baumhoff, Superintendent of the Lindell Railway Company of that city, and its operation has proved of the greatest value in giving exact and definite information as to the operation of the road and running time of the cars.

Among a few of the points it shows are the following: 1. Whether the cars are running regularly or irregularly. 2. Whether there is a stoppage at any point. 3. How long the stoppage lasts. 4. How many cars were blocked. 5. When the trouble is removed and the road begins operation again.

These are things every superintendent would like to know while sitting in his office, and he is thus enabled to take a birdseye view of the operation of the road, with an exact record before him for the preceding two hours of how the cars have been running at each point. If there is a bad break he can send instruction to fill in with extra cars. If there is irregularity in the running time without good cause, he can check it, and if necessary trace the exact car which is responsible for being off schedule time.

The manner of obtaining all this information is extremely simple, and in fact the success of its operation probably depends upon this simplicity.

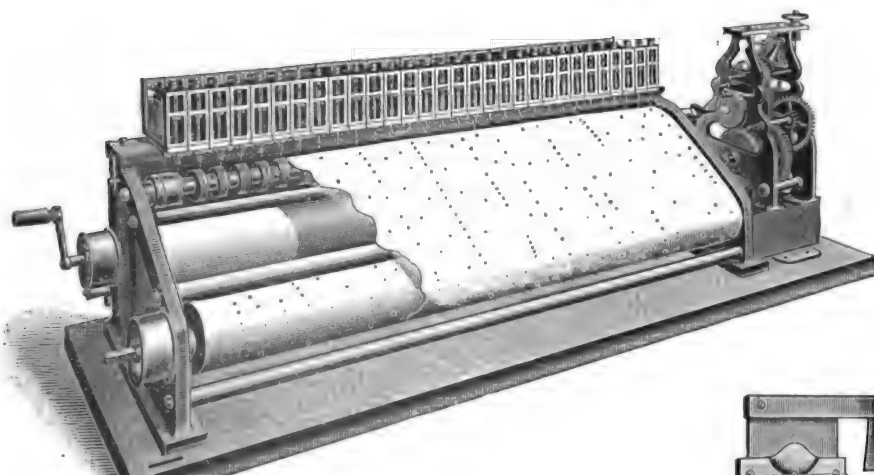
The chronograph which is illustrated in the accompanying engraving, Fig. 1, consists primarily of a sheet of paper moving at a uniform rate under a series of pens or points, operated by magnets. Each magnet point represents a point on the road, and each time a car passes this point on the road it makes contact, and the magnet point on the chronograph makes a prick mark on the paper. The illustration shows a thirty point chronograph. That is, it will give a record of how the cars are running at thirty different points on the system, and by selecting these judiciously this will be practically a complete record even on a large system having many branches.

The arrangement of parts as shown is as follows: On the frame is mounted the back roller to hold a supply of paper, the front roller on which to roll up the record, the top plate holding the magnet points, and the top roller which gives the time movement to the sheet. This top roller is a series of grooved wheels, one for each magnet point. This is one of the most important parts of the device, as the movement of the sheet must be absolute and exact or the time record will be inaccurate. This roller is operated by a high class and powerful clock movement shown at the right hand side, which moves this time roller one revolution per hour. This is proportioned to give the paper exactly four inches of movement per hour, or one inch for every fifteen minutes, and a line running on a one minute schedule will therefore show fifteen cars or prick marks to the inch, a five minute schedule three to the inch, and so on. A break of two inches would show a stoppage of thirty minutes at that point, and a record showing even, regular points indicates that cars are running all right at that point of the road.

These sheets are dated and filed for reference, and thus a record of the operation of the road is kept, and improvement in service is bound to result from the information thus obtained.

It gives a record of time it took to repair certain damage, and of the exact time at which anything which interfered with the operation occurred. In fact it is a living map of the road, and brings the entire system under the eye of one man at headquarters, at the same time making a permanent record of its operation. It is a report right up to the minute, just when it is needed, and when minutes mean money, and not at the end of the trip or day when it is too late to provide for trouble which may have occurred.

The engraving, Fig. 2, shows an improved type of trolley contact used in connection with this and other signalling apparatus.



Figs. 1 and 2.—The Emerson Chronograph for Electric Roads.

AN INTERESTING MISSOURI SCHEME.

An installation of exceptional interest is now in progress under the direction of Mr. R. G. Scott, the secretary of the Ha Ha Tonka Park Land Company, Ia. The Des Moines, Mo., Central & Southern Railway, which Mr. Scott represents, are about to file their articles of incorporation. The company will run an electric railway of standard gauge some sixty miles north and south of Ha Ha Tonka. Twenty-five miles of track will be built south to Lebanon, and about 40 miles north to some point on the Missouri Pacific system, to begin with, and arrangements are being made to extend the lines largely if necessary. The road will pass through an interesting and important tract of country. The enterprise will include other applications of electricity. It is proposed to light the town of Ha Ha Tonka from the same source of current as supplies the railroad, and to have special illumination for the ornamental grounds and the very fine caves possessed by the city. The company have not yet decided what their motive power will be. That depends somewhat upon the developments made along electrical lines within the next year. An immense water power is available, and it will probably be turned to account for the generation of current. The company have not yet selected their plant; they want the best in the market. The power house will be built of fine stone, of which the company have an abundance.

A LONG ROAD FOR NEW YORK STATE.

A special dispatch of Oct. 1 from Hudson, N. Y., says: The Columbia County Electric Railway Company, recently incorporated with a capital of $400,000 to operate a street surface electric railroad for a distance of fifteen miles between Hudson, Philmont and Stockport station, has absorbed the Hudson Electric Railway and the Citizens' Electric Light and Power Company.

TROLLEY CAR AS A DEADLY WEED KILLER.

A special dispatch from Lansing, Mich., says: A new wrinkle in the use of electricity will be experimented with at the Agricultural college next week. Prof. Woodworth at a recent meeting of the Natural History Society spoke of the matter and gave some new ideas. He described a new wrinkle for agriculturalists. It has just been discovered that electricity will kill vegetation. By having a current passed through an insulated fishpole at the rear of a street car, at the end of the pole being numerous fine wires just touching the tops of the weeds in the track, the shock that the weeds will receive is said to kill them instantly, and clear to the roots. Prof. Woodworth does not see why this method of exter-

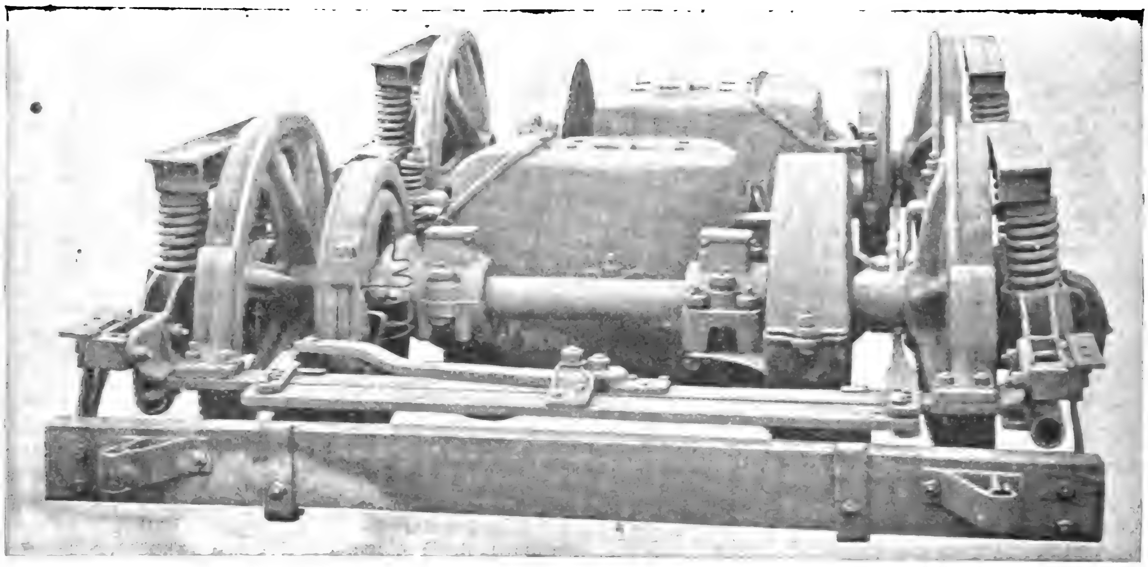


FIG. 1.—G. E. MOTOR TRUCK EQUIPPED WITH SPERRY BRAKES.

minating weeds cannot be used to advantage on our country roads. By taking a wheelbarrow or a wagon supplied with a storage battery and the wires dragging on the ground, he sees no reason why Canada and Russian thistles cannot be removed from farms, being much better than using salt. Some experiments will be tried very soon by Prof. Woodworth on the campus and farm to see if the method can be successfully used.

ILLINOIS CENTRAL TO ELECTRIFY ALL ITS SUBURBAN SYSTEM.

IN view of the recent half-hearted contradiction of the statement that the Illinois Central intended to resort to electricity, the following item from the daily papers is of interest:—

"With the settlement of the lake front controversy in Chicago, the Illinois Central Railroad is ready to take up the matter of changing the motive power of its suburban service from steam to electricity. John Dunn, assistant to President Fish, says that within the next few months all the suburban trains, both local and express, will be run by electricity."

This looks tolerably authentic.

THE SPERRY ELECTRIC BRAKE FOR STREET RAILWAY SERVICE.

The Sperry electric brake was shown at the Montreal Convention by the General Electric Company in connection with two G. E. 800 motors, Fig. 1.

In this brake method, the controller not only controls the motors, but at the same time operates the brake, starting, accelerating, retarding and braking the car. When making a stop, the controller handle is thrown from running to braking position—and electricity does the rest. The operations are the conversion of the motors into special dynamos for generating current at very low speeds, the cutting of all connections with the trolley current and the application of the brakes. The rheostats and contacts used to control the motors in running the car, also control the current generated by the motors and needed to apply the brakes. The braking action is two-fold. The rotating armature of the motor, instead of tugging ahead, with its fly-wheel action by its momentum, is itself pulling back and more or less powerfully braking the car through the gears by the retarding effort of its magnetic field while generating the braking current. The power, therefore, required to perform this work, is taken from the energy of the moving car. Not only is the car thus retarded, but the brakes arrest the motion of the wheels direct with a powerful force under perfect control of the motorman. The combined electric brake and series parallel controller is only the K2 controller writ slightly larger, Fig. 2. The brake mechanism which is readily attached to the motor and axles—consists of a cast iron disc keyed to each axle and a compact electro-magnet, facing each disc and attached to the motor frame, preventing it from revolving, by suitable lugs. The maximum current in the brake circuit is regulated by a limit switch adjusted to limit the current automatically to an amount just under the slipping point of the wheels. Independently of this switch, the brake pressure can be graduated by the controller handle, and a smooth, even motion is secured on descending long grades. The disc and shoe are lubricated by a graphite brush, carried in the shoe and pressing against the brake disc. This prevents excessive wear from friction and reduces the resistance between the shoe and disc, an important feature, as the eddy currents set up in the brake and shoe are even more effective in stopping the car than the simple friction between the shoe and disc. The installation connections of this mechanism are not complicated. The two sets of brake magnets are in series securing the same retarding effect on both axles.

The General Electric Company is owner of many fundamental

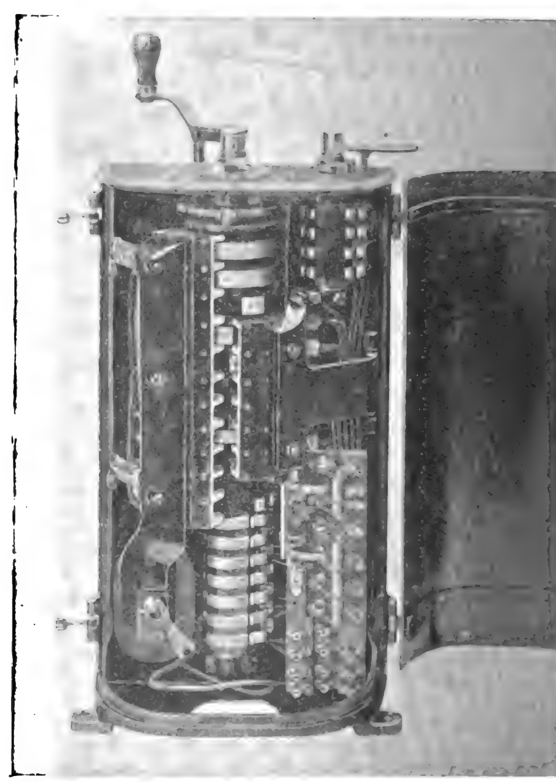


FIG. 2.—COMBINED BRAKE AND SERIES PARALLEL CONTROLLER.

patents on electric brakes, notably those of Van Depoele and Sprague, and has recently acquired the patents of Elmer A. Sperry, who has devoted a large share of his time during the past few years to the perfection of a thoroughly commercial and practical brake. Since the acquirement of the Sperry patents, the engineers of the General Electric Company, in conjunction with Mr. Sperry, have been engaged in working out and perfecting the details required to adapt the electric brake to the series parallel method of control.

MISCELLANEOUS.

LOCAL ANNEALING OF HARD FACED ARMOR PLATES.[1]

BY HERMANN LEMP, JR.

One of the latest advances in the making of protective armor for battle-ships, or even forts, has been the introduction of what is known as the Harvey process. For those not conversant with the latter, I will briefly state that it consists in taking an ordinary low carbon steel plate and introducing an additional percentage of carbon into the surface metal, thus changing the crust to the depth of about an inch, into a steel resembling tool steel. A plate thus treated, is lastly water-hardened, similarly to an ordinary tool, and by experience has shown to offer, under equal conditions, more resistance to the impact of a projectile than any other armor known. And therefore we will take this as an illustration of hard faced armor. The extreme hardness of the surface of a Harvey plate, while exceedingly valuable in preventing projectiles from piercing it, has a disadvantage when it is required to be pierced by a drill and tap. Such holes may be required either for fastening ladders, swivels or other appliances to the hull of the vessel, or to fasten T flanges supporting the deck to barbettes or turrets.

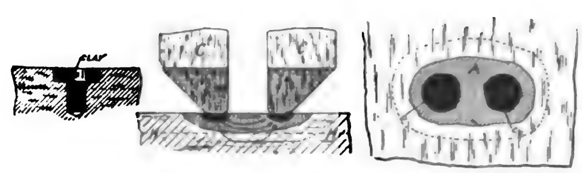
The methods heretofore used to produce these holes were principally two: 1. To protect the surface of the plate in patches or strips, to prevent carburation, wherever holes were expected to be drilled.

2. To make accurate drawings and patterns of each plate beforehand, to which all holes are drilled before plate is hardened.

Plan No. 1 was practiced in the United States until it had to be abandoned. In practice it was found that numerous alterations in construction, errors in either draughting room or mills, made it necessary to pierce holes where no provisions for annealing were made. It also happened quite frequently, that the method for prevention of carburation did not always work satisfactorily, and while white paint indicated well enough where soft metal was expected, very often hard metal was actually found. Hence it was patent from the first that some process was needed to rectify errors of this kind. Experiments were then made with oxy-hydrogen blowpipe, or the electric arc, to anneal such spots as were required to be drilled, and numerous mechanical devices for drilling, with drills of every design and method of tempering, were tried, until it seemed that the case was without a remedy.

It was at this stage that the problem was referred to the Thomson Electric Welding Co. of Lynn, and experiments were immediately undertaken to solve it. The process and apparatus necessary to carry it out, all resulting from the experiments undertaken, will be described presently.

The second method, which is used in England, has the advantage over the first, that there is no difficulty in carrying it out, provided there are no alterations made, and no errors committed. The present method of construction seems to be, to make, beforehand, a complete *model* of the vessel to be built; then make accurate drawings and full-size patterns of every plate, giving the exact location of every hole. These are then bored, tapped and countersunk to a depth of approximately ⅜" and of a much larger diameter, filled with clay, and then the plate as a whole is heated and hardened with water. (See Fig. 1.) This method works



FIGS. 1, 2 AND 3.

apparently all right, although in spite of drawings and models, errors are made. There is no doubt, however, that it is a slow and very costly method of working, and would hardly ever be resorted to in the United States.

From the above it seems clear that there has existed a need for a process by means of which isolated spots, regardless of location, might be annealed so as to permit drilling and tapping. If, by sending a current of large volume through any spot thus to be treated, the spot is brought to a temperature of approximately 1,000° F., there can be no doubt that the temper has been withdrawn. Experiments carried out to that effect at once showed, however, that upon taking off the heating current the heat was so rapidly conducted away by the surrounding metal masses as to cause the heated spot to become chilled just as effectually as if it had been plunged into cold water. No method of outside protection of the heated spot would prevent this, and the *gradual* cooling of the spot had to be attained by different means: namely, a gradual and slow withdrawing of the heating current.

The method of introducing the annealing current is best shown in Fig. 2. C C are two copper contacts cooled by water circulating inside. The current enters the plate by one end, and leaves it by the other. Right under the contact, the metal comes to a bright cherry heat (shown in black), while the portion intervening and partly surrounding the contacts acquires a temperature of just a visible red. Line H H indicates where the influence of the Harvey treament stops.

The shaded portion in Figs. 2 and 3 shows the zone softened

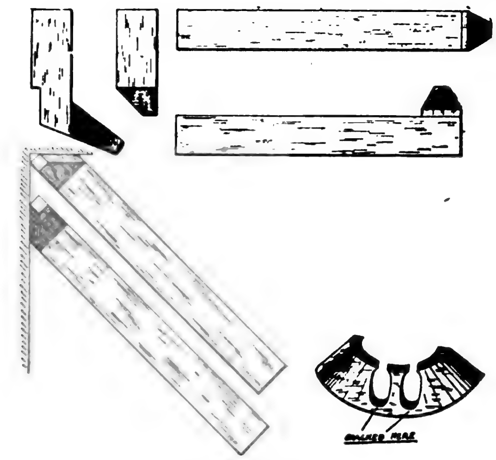


FIG. 4 AND 5.

and ready to be machined, while the dotted line shows how far the heat radiation would cause the metal to turn blue. When cooled, the annealed portion shows a chocolate color, while the place where the contacts have been resting, is scaled and hard, and cannot be touched by a tool to a depth of about ⅛". These places can again be annealed later on, if required.

The apparatus necessary to carry out this process consists of the generator, the annealer proper (transformer) and the regulating apparatus.

The generator is commonly a separately excited alternator of variable potential, of a maximum of 300 volts and 100 amperes. The frequency, preferably, should be low, 50 cycles per second being used. When more than one annealer is to be run simultaneously from one generator, constant E. M. F. of the latter should be used, and each annealer regulated separately by a reactive coil. The annealer proper is a transformer similar to the well-known welding transformers. As the apparatus is to be operated outdoors, on board of vessels during construction, it is important that the same may be handled with immunity from electric shocks, even when operated in mist and rain.

To meet these conditions a copper-clad type of transformer is used, one in which the secondary is composed of two copper castings each having a rectangular groove, which two halves, when bolted together, form a closed rectangular frame in which the primary is held enclosed. The hollow space intervening between primary and secondary is moreover filled with a heavy oil, which acts both as the insulator and conductor of heat from primary to secondary. The secondary, by completely surrounding the primary, affords an excellent mechanical protection, and prevents electric as well as magnetic leakage. The primary is a copper ribbon insulated with asbestos, and the ratio of conversion is 100 to 1. The transformer has two trunnions fastened to its sides, in a line a little above the centre of gravity, which trunnions swing in bearings, part of a yoke which straddles the whole. The yoke in its turn has a hook which may be secured to the latter at any place of the arch, thus allowing the transformer to be suspended, like a compass in gimbals, in any position desired.

It goes without saying that the copper castings which compose the secondary are cut through at one place in the circuit. On either side of the cut, two short platforms form the base for copper contacts of various shapes and sizes, by means of which the currents are made to enter and leave the plate to be annealed. These copper contacts are of forged copper, hollowed out to receive water circulation for cooling purposes, and terminate in narrow tips rounded at the end.

The weight of the whole annealer, being approximately 1,000 pounds, is sufficient to give proper contact pressure for all work on a horizontal plate. When inclined surfaces, vertical or otherwise, are to be worked upon, the transformer is suspended so that its weight shall not interfere with the contact pressure, which is obtained for work by bracing the contacts directly with wooden wedges against any object near by. On the outside of a hull, it is proposed to use a pair of electro-magnets, which are made to hold themselves against the iron hull, and form a support for the

1. Abstract of a paper read before the Amer. Inst. of Elec. Engrs., Oct. 23, 1895.

annealer. Fig. 4 shows some of the various shapes of contacts that are used in various positions.

The remarkable thing is the great amount of current that is being carried by the copper contacts into the plate. The contact surface is seldom more than about ½" square, and yet 10,000 amperes are made to flow through it continually. This is equivalent to 40,000 amperes per square inch, a density which is only possible an account of the thorough cooling by the water circulation.

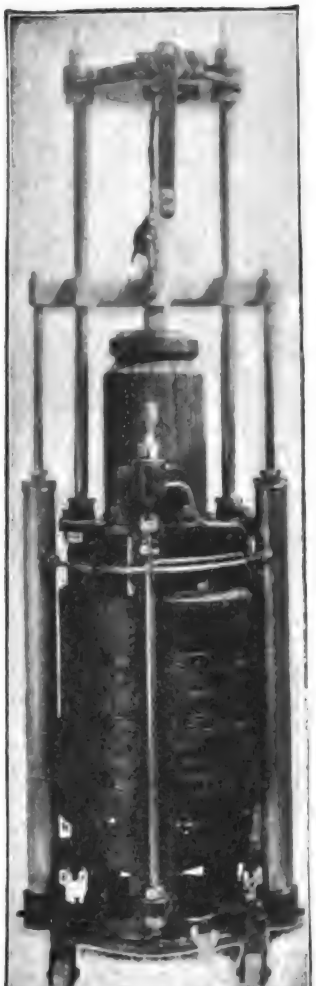
The regulating apparatus is in most cases simply a rheostat in series with the field of the generator. When more annealers than one are run simultaneously from one generator, as mentioned before, a reactive coil is interposed between the two, and this latter has been made automatic; that is to say, provided with a dash-pot, which permits the current to be reduced uniformly and at any given rate it is set for.

This reactive coil, Fig. 6, is composed of a solenoid coil of cable, well insulated, having a movable laminated iron core which is raised out of the coil by means of a leather strap and winch. The core is composed of thin iron strips placed side by side around a circle, and projecting radially from the same, and being held on top and bottom by a slate disc, in a manner similar to the securing of the copper segments of a commutator. No insulation of the core is necessary, and good ventilation is obtained. The core once raised out of the coil tends to return by gravity and the attraction of the solenoid, but is checked in its descent by a pair of dash-pots, one on each side of coil. These latter communicate with each other, top and bottom, and have one of the pistons provided with a valve which opens when the core is raised, and closes when the core descends. The dash-pot cylinders are filled with a light mineral oil, which does not freeze nor clog under any ordinary conditions of temperature. An adjustable by-pass valve allows the oil to flow from the tube to the top side opposite. By opening or closing this valve more or less, any rate of descent and, consequently, diminution of current, can be uniformly obtained, without requiring any skill on the part of the operator.

The annealing operation is carried out as follows: The transformer is placed in position, the contacts touching the plate either side of the place marked to be annealed, and the primary current brought up by means of a rheostat to from 75 amperes to 90 amperes for about two minutes, according to the size of spot to be annealed, which will bring the metal to a dull red heat, a temperature at which a pine stick catches fire when held in contact with the plate. If no reactive coil is used, the current is now diminished by turning the rheostat one point every minute. If the reactive coil is used, the core is now raised by winch, the coil put in circuit by opening a short-circuiting switch, and then is allowed to descend on its own account. The operation generally takes *seven minutes*, all told. Fig. 7 shows the apparatus in operation on the "Massachusetts" and "Oregon." No difficulty has been experienced from the beginning. The annealing of individual spots was, however, only the stepping-stone to a more important work of a similar nature, work which was about to be given up, owing to what was considered insurmountable difficulties.

In the construction of a modern man-of-war, there are many armor plates which act as shields to the guns, and have to be perforated to allow the gun muzzle to pass through and to be either raised or lowered. Some of these shields are circular or oval, with narrow edges around the ports, in the case of Harveyed plate. To perforate these shields after carburation, and before being water-hardened, was the only possible way, since previous experiments had shown that prevention of carburation could not be relied on, and no process was known to anneal the plate locally after hardening. The hardening of a plate once perforated, showed itself to be, however, almost impossible; in fact, a matter of chance. In most places the plate cracked in two as shown in Fig. 5, or the whole plate became distorted in such a way that it could not be used. As individual spots for holes could be annealed there could be no doubt that a series of annealed spots could be likewise obtained by the electric process, following a line along which a cutting tool was expected to be run. The first attempt, therefore, and made in England, was to anneal a number of spots in proximity to each other in such a way that the annealed zones should overlap each other.

As described above, it is very important that the temperature of any individual part should be gradually and slowly withdrawn; and while for individual spots the only possible way was to do this by gradually diminishing the current, it was obvious that when a line was to be annealed, instead of annealing a number of spots side by side, the same effect of withdrawing the heat gradually



Figs. 6 and 7. Reactive Coil and Transformer for Annealing Armor Plate.

from one portion could be obtained by moving the apparatus itself relatively to the plate to be treated. The rate of this movement, of course, depended upon the rate at which the temperature should be allowed to fall in any particular spot to prevent chilling. The apparatus was therefore arranged to be moved along a line to be annealed, the motion being obtained by an ordinary screw and nut held in a bracket, the nut being turned at a predetermined rate controlled by a watch. It was found that a speed of about ¼" per minute was sufficiently slow to ensure thorough annealing.

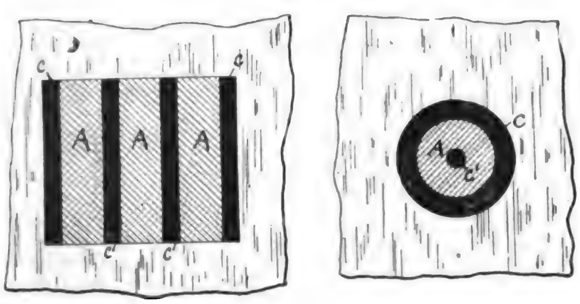
The copper contacts were of the simplest kind, as described above, bedding themselves partially in the surface, and when being dragged along by the screw and nut, raised in front of themselves a burr or chip similar to a planing tool. After a whole day's continuous use the copper contacts were found intact, while a number of chips from the steel surface was lying about. We thus had the peculiar phenomenon of a hard steel chip cut with a copper tool.

Upon the completion of the work, it was found that a strip about 2¼" wide throughout the length over which the machine had been moved, could be operated upon by drills or a shaper, in a manner as easily as if it had never been hardened before.

In the work just described, the apparatus was moved about, but in regular practice it would be better to construct a machine consisting of a large bed, on which the plate to be treated may be fastened and moved in any direction automatically at a predermined speed, while the annealer proper is suspended in a given position above the plate. The annealing operation occupies but a small percentage of the time required for the cutting.

It is unnecessary to state that when the apparatus is used for continuous annealing, the primary current is kept at a nearly constant value, the diminishing of heat at any individual spot being obtained solely by the moving of the apparatus from it.

As mentioned before, the places where the contacts are passing over the plate, being brought to a higher temperature than any other, remain hard. Experience has demonstrated, however, that they may be re-annealed later on, by treating the spots in the same way as any other hard spot on the plate. By this means we are therefore able to anneal any shaped portions, not merely lines,



Figs. 8 and 9.

This is best seen in Fig. 8, in which a series of strips are annealed side by side (shown in shaded lines A). The hardfaced surface is then removed on such places by a planer and drill; the machine is then run a second time over the annealed strips, resting it this time on the bottom of the groove and on the softer metal, thus annealing the ridges C left between the annealed strips, on which ridges the contacts were running previously. When all these strips are annealed they may be removed by machine tools without any further difficulty. In a similar manner a large round place may be annnealed, as shown by Fig. 9. The transformer is set on the plate, one contact resting on C', the other at any other place in circle C; the apparatus is then slowly revolved around contact C' as a center, until the second contact has completed the circle C. The shaded portion A represents now the annealed surface, which is removed by a cutting tool. The contacts are then made to rest on either side of the center C', and the latter is annealed and removed in its turn.

The apparatus may also be used for the reversal of the annealing process; that is to say for creating isolated hard spots in soft tool steel by sending a current through the spot to be hardened until it reaches a bright cherry heat, and then suddenly removing the current or machine.

Various other applications will suggest themselves in the operation of this process, already adopted by the United States Government. It may be used in the construction of burglar-proof safes, for dies and punches, for projectiles, and other articles of a similar nature.

IN THE NAVY DEPARTMENT.

"Please send me The Electrical Engineer for one year, beginning with the number containing the first Data Sheet. Also morocco 'Data File Case.' I enclose P. O. Order for $8.60."

Prof. O. G. Dodge, U. S. N.,
Bureau Yards and Docks, Navy Dept.

THE CHICAGO WORLD'S FAIR IN MINIATURE AT ATLANTA.

An exhibition of a perfect model of the World's Fair, which has just been completed at a cost of $60,000, was shown through the courtesy of the directors of the Miniature World's Fair Exhibition Co., on Monday evening, October 7, at the erecting shops on 63d street and Sheridan avenue, Chicago.

The work of construction occupied a period of nearly two years, as many as seventy-five men working on the model.

The miniature is on a scale of $\frac{1}{16}$ the size of the original World's Fair. The buildings are on the ground plan, which has been modeled exactly after the original ground plan of the Exposition, the plans for this as for all of the buildings being kindly furnished the Exhibition Company, by Director General Davis, Director of Works Burnham, and the various State officials having the plans of their State buildings in charge. The dimensions of the miniature complete are approximately 65 x 48 feet. The lagoons are shown filled with water and the trees have been reproduced on the grounds and wooded island. The buildings are constructed of white holly, staff and composition. Each piece is made and fitted into its proper place, the number of separate pieces in Machinery Hall alone being 22,000. The Intramural Electric Railway with its numerous stations is also very perfectly reproduced, even the third rail being in evidence.

The method of lighting is electricity, the miniature requiring 800 amperes at 110 volts. The arc lights on the grounds are the smallest that have ever been made, the Western Electric Co. having had a man in Europe experimenting on these for several months; they are about the size of a three grain capsule and give an astonishing amount of light. There are also numerous ½ candle incandescent lamps interspersed through the grounds, as well as for illuminating the interior of the State buildings and the fancy illuminations such as the dome of the Administration building, and the Court of Honor. The large buildings will have 16 candle lamps placed inside for lighting purposes, the rays of which will reflect through the miniature windows. The effects of sunrise, daylight, twilight, moonlight, and—electric light,—will be produced by means of rheostats in a manner similar to the effects produced in the Scenic Theatre shown by the Western Electric Co. at the World's Fair.

In order to appreciate the beauty of this wonderful piece of architecture it is necessary to see it, and even then the detail can scarcely be appreciated without a close examination of the methods of construction. The ground plan will have a scenic wall for a background and the Miniature Fair will be viewed from a raised platform. It is a work of art which will be shown in all the principal cities of the country and of Europe, and one which cannot fail to be appreciated wherever it may go. The Company is exhibiting the miniature at the Atlanta Exposition, where they have a building on the Exposition grounds between Machinery Hall and the Mines and Mining Building.

ELECTRICALLY DRIVEN OCEAN STEAMERS.

The description of the work now being done with electric launches in this country, which we gave in our issue of Oct. 16, demonstrates clearly that the industry has a solid foundation, and that henceforth the electric launch will play a prominent part as a means of conveyance by water, whether for pleasure or profit.

The work has thus far been confined to small craft, but there are some who believe that a broader field exists for electrical navigation, and indeed that sea-going vessels will some day be driven electrically.

Among those who have given considerable thought and study to the subject is Mr. A. S. Hickley, President of the Hickley Launch and Electrical Manufacturing Co., of Asbury Park, N. J., whose electric boats we illustrated in the early part of this year. It has been Mr. Hickley's idea for many years that the vessels that cross the Atlantic are making too slow time. The reason is that they cannot drive their propellers fast enough with the amount of power behind them without shaking the boat to pieces. Mr. Hickley's plan is to put a powerful engine, say, a compound condensing Corliss engine of the slow speed type, connected directly to a multipolar generator, giving, say, 500 volts potential. Then directly upon the shafts of the propellers he would put the armatures of the motors, which are to drive the propellers. These can easily be made to run from 600 to 900 revolutions per minute, whereas the engine is probably only making 60 to 80. It will be seen that in this way there would be scarcely any vibration in the ship, and the propellers dipping in and out of the water caused by rough weather, would not affect the main engine and jar the vessel from stem to stern as at present.

Mr. Hickley intends to take his 35-foot boat and lengthen it a few feet making probably 40 feet of it, and fitting it up with an engine, dynamo and a pair of motors to demonstrate what has been said above.

The present flat bottom 35 foot boat will be converted into a round bottom by the use of galvanized iron or copper vessels fitted underneath close to the deep keel, fitted to carry coal oil or naphtha for generating steam.

SOCIETY AND CLUB NOTES.

THE AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION.

THE Fifth Annual Meeting of the American Electro-Therapeutic Association was held in Toronto, Canada, on Tuesday, Wednesday and Thursday, September third, fourth and fifth, 1895. The sessions were well attended. The first day's session began at ten o'clock, on Tuesday morning, the President, Dr. A. Lapthorn Smith, of Montreal, introducing Dr. James Thorburn, of Toronto, who welcomed the visiting members on behalf of the resident profession. Dr. Charles R. Dickson in an address also welcomed the members. The President then read his address on "Electro-Therapeutics in General Practice." This was followed by the reading of the Reports of the Committee on Scientific Questions. Then followed the reading of the papers in their regular order. In the evening the members were invited by the President of the Toronto Street Railway to a ride around the city, in his private car; Mr. James Gunn, the Superintendent, showed the members the power house of the company.

The second day's programme was carried out as per schedule. The executive session was held in the afternoon, the election resulting in the selection of the following officers for the year 1895-1896, viz: President, Dr. Robert Newman, of New York City; Vice-presidents, Dr. Holford Walker, of Toronto, Canada; Dr. D. B. D. Beaver, of Reading, Pa.; Treasurer, Dr. R. J. Nunn, of Savannah, Ga.; Secretary, Dr. Emil Heuel, of New York City; Executive Council, Dr. W. J. Morton, of New York City; Dr. G. Betton Massey, of Philadelphia, Pa.; Dr. W. J. Herdman, of Ann Arbor, Mich.; Dr. Emil Heuel, of New York City; Dr. Wendell C. Phillips, of New York City.

In the evening the resident profession, who had taken a lively interest in the proceedings of the Association, tendered to the members a reception at the Toronto Athletic Club. The chairman of the Committee of Arrangements, Dr. Charles R. Dickson, had arranged a very fine concert, which was followed by a collation.

The third day was devoted to the transaction of unfinished business. By the labors and influence of Dr. C. R. Dickson the members enjoyed a very pleasant afternoon at the Toronto Exposition, as the guests of the president of the exposition, Mr. John J. Wittrow. In the evening, the members were the guests at dinner of the Board of Directors of the Exposition. This was followed by a visit to the Fall of Lucknow and the Pyrotechnic Exhibition.

The president has appointed the following committees for the year 1895-1896, viz.: Committee on Induction Coils and Alternators: Dr. A. H. Goelet, Chairman; Dr. G. Betton Massey, Mr. A. E. Kennelly. Commmittee on Meters: Dr. M. A. Cleaves, Chairman; Dr. O. B. Douglass, Mr. W. J. Jenks. Committee on Static Machines and Condensers: Dr. W. J. Morton, Chairman; Dr. W. J. Herdman, Dr. J. H. Kellog. Committee on Constant Generators and Controllers: Dr. W. J. Herdman, Chairman; Dr. Robert Newman, Mr. R. G. Brown. Committee on Electrodes: Dr. C. R. Dickson, Chairman; Dr. Lucy Hall-Brown, Dr. E. C. Riggs. Committee on Electric Light Apparatus for Diagnosis and Therapy: Dr. J. H. Kellog, Chairman; Dr. E. C. Riggs, Mr. J. J. Carty.

It was decided to hold the next, the Sixth Annual Meeting of this Association, in Boston, Mass., in the latter part of September 1896.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The regular monthly meeting of the Institute was held at 12 West 31st street New York City Oct. 23d. Vice-President Crocker presided, and after officially announcing the death of Past President Franklin Leonard Pope, he stated that by special request of President Duncan, Mr. Thomas D. Lockwood had prepared for presentation the following resolutions which were adopted:

Whereas, The American Institute of Electrical Engineers has heard with heartfelt sorrow the sudden death by a lamentable accident, of its Past President, Franklin Leonard Pope; and Whereas, We the Members, Council and Officers of the Institute desire to express our profound realization of the bereavement we have sustained, and the sincere grief we experience; and to record in fitting terms our keen appreciation of the great worth, and high qualities of our late fellow member; his eminent services to our organization, and his able, unwearying and successful work in applying electrical energy to many useful purposes, it is therefore

Resolved, That by the death of Mr. Pope, called away in the full fruition of manhood, and the meridian vigor of intellect, the Profession at large has suffered an incalculable loss, and the Institute has been deprived of a most distinguished and valued member, and a wise and sagacious counsellor, endeared to many members by long, pleasant and affectionate intercourse, and esteemed and respected by all, no less for his kindly and warmhearted nature, and dignified simplicity of character, than for his universally acknowledged genius and great ability.

Resolved, That we hereby express the poignant grief wherewith we contemplate the sad event which has taken from us, one, who, whether in the earliest days of our association co-operating in its successful establishment, urbanely and efficiently presiding as our chief executive officer at business and social meetings, discreetly and judiciously performing the unassuming duties of a member of the Committee on Editing or in the capacity of an individual member, conserving the interests of harmony and stability, has uniformly had the dignity of the Institute at heart, and has assiduously, cheerfully and faithfully labored for its welfare. And while we sincerely mourn the loss of an associate so eminent and useful, thus suddenly withdrawn from the activities of this present life, we most earnestly grieve for the parting from a friend so sincere, faithful and true.

Resolved, That we extend to his stricken family our tenderest sympathy, in this, the hour of their affliction, and that in testimony thereof, a copy of these resolutions be forwarded to them.

Resolved, That these resolutions be appended to the minutes of the Council, and be published in the Transactions of the Institute.

The regular business of the evening was then taken up, a paper being read by Mr. Hermann Lemp of Lynn, on "Local Annealing of Hard Faced Armor Plates." This was followed by a paper on "The Rating and Behavior of Fuse Wires" by Prof. W. M. Stine, H. E. Gaytes, and C. E. Freeman of Chicago. In the absence of the authors this paper was read by the Secretary.

At the Council Meeting in the afternoon the following Associate Members were elected:—Harry Byrne, Organizer, The Nat. School of Electricity, Chicago, Ill.; residence, 5620 Drexel avenue. Edmund P. Coles, Special Tester, General Electric Co., Schenectady, N. Y.; residence, 240 Union St. George W. Colles, Jr., Draughtsman, Westinghouse Electric & Mfg. Co., Pittsburg, Pa. L. G. Crawford, Supt., Repair Department General Electric Co., Chicago, Ill. Harold W. Shonnard, Designer and Foreman, The Electric Self Playing Piano Co., 338 W. 36th street, New York City; residence, 23 W. 43d street, Bayonne, N. J. Arthur F. Walker, Supt. and Electrical Engineer, Edison Light Co., Grand Rapids, Mich.

MARRIED.

DAVIS-COLLINGS.

AT the Central Church, Rochester, N. Y., on Oct. 15, Mr. B. E. Davis, who is well known as a representative of the firm of Pass & Seymour, was married to Miss Gertrude Collings. A reception followed the wedding, and the gifts were numerous and beautiful. Mr. and Mrs. Davis will make their home in New York.

FLOY-VAN BENSCHOTEN.

MR. HENRY FLOY, of the Westinghouse Co., Pittsburgh, was married on Oct. 22, at East Orange, N. J., to Miss Alice Van Benschoten. The ceremony was performed by Bishop Hurst, of Washington. The happy pair left for an extended trip south, and will take up their residence in Pittsburgh on their return.

PERSONAL.

MR. FRANK ELLMAKER, superintendent of the Middle Division of the Pennsylvania Railroad, has resigned to accept the superintendency of the Consolidated Traction Company of New Jersey. The position involves complete charge of the operating department of the entire system of the company, which controls the street railways of Jersey City, Newark, Elizabeth and Paterson.

MR. D. H. LOUDERBACK, a leading factor in many of the street railway enterprises in Chicago, the president of the Tri-City Railway Co. of Davenport, Ia., and at one time a prominent telephone man, is afflicted with serious eye trouble, and is now in the hands of an oculist. While out woodcock shooting some years ago, he received in the left eye part of the discharge from a friend's gun.

MR. ALLEN SCHEWMON, manager of the Belle City Street Railway company, Racine, Wis., has resigned to accept a position as manager of the Green Bay Electric Light and Gas plant. Jackson I. Case, who has been connected with the road for the past few years and is the heaviest stockholder, will succeed Mr. Schewmon as manager. Mr. Schewmon went to Racine in 1891 and he with Dr. Holmes, now owner of the Green Bay & Fort Howard Street railway, constructed the road, which is considered one of the best in the country.

MR. G. W. FOSTER, general superintendent of the North Texas Division of the Southwestern Telegraph and Telephone Co. has been appointed assistant paymaster general of the Texas State forces with the rank of major. He resides in Dallas.

MR. G. F. PACKARD, late of the General Electric Company's designing and engineering force, has, with the beginning of the present month, entered the employ of the Fort Wayne Electric Corporation, at Fort Wayne, Ind., where he is at present engaged in designing a new line of direct-driven power and lighting generators soon to be brought out by that Corporation. For nearly eight years past Mr. Packard had been connected with the Thomson-Houston and General Electric Companies at Lynn and Schenectady.

Legal Notes.

HISTORY OF THE THOMSON-HOUSTON ARC REGULATOR LITIGATION.

The final decision of the United States Circuit Court of Appeals for the Seventh Circuit in the suit of Thomson-Houston Electric Company *vs.* the Western Electric Company and Enos M. Barton concludes one of the most important patent causes relating to electrical inventions. The decision favorable to the Western Electric Co. has already been noted in THE ELECTRICAL ENGINEER.

In 1879 Elihu Thomson and Edwin J. Houston applied for a patent upon an automatic adjuster for commutator brushes of magneto-electric machines. In this patent the applicants described and claimed a device for automatically adjusting the brushes upon the commutators of dynamo-electric machines, "whereby an automatic adaptation to variations of circuit resistance is secured." This device consisted of a relay adapted to bring into service a motor which shifted the brushes upon the commutator. The relay received its current from an accessory brush placed in advance of the main brush upon the commutator of the dynamo-electric machine.

The patentees of this "first" patent, which was issued as No. 223,639, July 20, 1880, both testified that up to the time of taking out of this patent they had not made the invention of current regulation and did not appreciate that the brushes upon the commutator of a dynamo-electric machine could be shifted so as to keep the current constant. Whether this is so or not, the fact remains that it was known to electrical engineers of that date that shifting the brushes upon the commutator of a dynamo-electric machine could be so performed as to keep the current flowing in the circuit constant notwithstanding the variations of the resistance in the circuit. Weston testified that he had manually shifted the brushes for this purpose from 1876.

It was not long after the issue of this patent, No. 223,639, that Thomson and Houston recognized their failure to cover the device broadly for automatic current regulation. A second application upon substantially the same apparatus was therefore filed and this patent, called generally the "second patent," had broad claims upon automatic brush-shifting current-regulation. It was this second patent, No. 238,315, upon which suit was brought against the Citizens' Electric Light Company of Boston, users of Wood arc-lighting apparatus. A decision was secured in this suit in August, 1888, sustaining the validity of Patent 238,315 and finding the defendants, users of the Wood regulator, to be infringers. Suit was subsequently begun against the Western Electric Co. in the United States Circuit Court for the Northern District of Illinois, and, after years had been spent in collecting evidence, the case came to hearing in June, 1894, before Judge Grosscup, who rendered an opinion adverse to the patent early in the present year. From this decision of Judge Grosscup the Thomson-Houston Electric Company appealed to the Circuit Court of Appeals. The case was elaborately argued in June of the present year, and the Circuit Court of Appeals, as announced by us last week, has just handed down its opinion, affirming the decision of Judge Grosscup. The statement of facts occupies some 46 large pages of the opinion of the Court of Appeals and comprises voluminous extracts from the testimony of Mr. Charles E. Scribner, the main witness for the Western Electric Company.

In addition to the defense which was most strongly urged, namely, that of the first Thomson-Houston patent, No. 223,639, which showed substantially the same device as that of the later patent, No. 238,315, upon which suit was brought, the invention of Maxim of an automatic current regulator for dynamo-electric machines, which was applied to separately excited dynamos running incandescent lamps in multiple arc, was urged as an anticipation of the patent in suit, and this defense also was considered to be adequate to defeat the broad claim of Thomson and Houston for automatic brush-shifting current-regulation.

AM. ELEC. & MFG. CO. vs. T.-H. INT. ELEC. CO.

The American Electric & Manufacturing Co. appeared before the Superior Court in Boston last week and asked for an injunction against the Thomson-Houston International Electric Co. to restrain the defendant from selling 559 shares of the American Co.'s stock held as collateral for a $30,000 note of the plaintiff.

PHILA. EDISON CO. vs. PENNA. LIGHT, HEAT & POWER CO.

The new local company in Philadelphia proposes to distribute heat, and the Edison Co. there, of which Prof. Marks is president, has taken action to secure itself against the damage that would result to its underground mains from the contiguity of the steam heating pipes. A preliminary injunction was granted last week. The consolidation which has just taken place between these two companies will not, it is understood, prevent the case from being pushed to a conclusion.

Inventors' Record.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED OCT. 15, 1895.

Alarms and Signals:—

Staff Apparatus for Working Single-Line Railways, I. A. Timmis, London, Eng., 547,890. Filed Dec. 1, 1893.

Electrical Succession Signalling or Calling System, J. G. Smith, New York, 547,897. Filed Jan. 14, 1895.

An electric selective or individual call device.

Fire Alarm, E. A. Speer, Toledo, Ohio, 547,900. Filed May 20, 1895.

When the temperature reaches a predetermined limit a precautionary alarm is given, and if the temperature increases to a predetermined danger point a second or fire alarm is given.

Electrical Succession Signaling or Calling System, J. G. Smith, New York, 547,942. Filed Jan. 14, 1895.

Details relating to an electrical selector or individual call system.

Interlocking Signaling Apparatus, C. Hansel, Easton, Pa., 548,161. Filed Mch. 5, 1895.

Dynamos and Motors:—

Electrical Transmission of Power, W. D. Baldwin, Yonkers, N. Y., 547,834. Filed July 3, 1894.

Relates to the Leonard system of motor control. Provides means to start the whole system of generator and motors when wanted and to stop it when not in use.

Electric Lighting Systems:—

Electric Car Lighting Apparatus, W. Biddle, Brooklyn, N. Y., 547,835. Filed Jan. 16, 1895.

The combination in a car lighting apparatus with the secondary battery and main and light circuits, of a dynamo having an armature with two or more sets of plates, and brushes to the separate coils of the armature, and means for separating one or more of the brushes for regulating the output of current from the armature in proportion to the speed of rotation.

Electrical Illumination, D. McF. Moore, New York, 548,126. Filed Oct. 13, 1894.

This and the following eight patents relate to the method and apparatus and their modifications for producing light in vacuum tubes as described in our last issue.

Electric Lighting System, D. McF. Moore, East Orange, N. J., 548,127. Filed July 19, 1895.

Electric Lighting System, D. McF. Moore, New York, 548,128. Filed Apl. 10, 1895.

Method of Electrical Illumination, D. McF. Moore, New York, 548,129. Filed Dec. 4, 1894.

Regulation of Electrical Phosphorescent Illumination by Magnetic Induction, D. McF. Moore, New York, 548,130. Filed Jan. 3, 1895.

Apparatus for Generating Phosphorescent Electric Light, D. McF. Moore, New York, 548,131. Filed Jan. 7, 1895.

Phosphorescent Electrical Illumination by Oscillation, D. McF. Moore, New York, 548,132. Filed Jan. 9, 1895.

Phosphorescent Electric Illuminating by Intermittent and Permanent Interruption in Vacuum, D. McF. Moore, New York, 548,133. Filed Jan. 24, 1895.

Electrical Illumination by Phosphorescent Flame, D. McF. Moore, New York, N. Y., 548,134. Filed Jan. 25, 1895.

Electrometallurgy:—

Electrical Gold and Silver Extractor, A. Williams & W. R. Phillips, Seattle, Wash., 548,150. Filed Jan. 24, 1895.

The amalgamated mass to be electrolyzed is placed in an insulated centrifugal and the terminal raised and lowered vertically.

Combined Diaphragm and Electrode, J. Hargreaves, Farnworth-in-Widnes & T. Bird, Cressington, near Liverpool, Eng., 548,162. Filed Dec. 31, 1894.

Consists in depositing directly upon a metallic permeable electrode a plastic mixture of alkaline earth and fibrous material, drying the same, and then steeping the plate in a solution of such a nature as to convert the alkaline earth into an insoluble binder.

Lamps and Appurtenances:—

Electric Arc Lamp, C. Beseler, Jersey City, N. J., 548,028. Filed May 4, 1895.

Improved feed for lantern arc lamps.

Incandescent Electric Lamp, S. E. Cox, Cleveland, Ohio, 548,036. Filed July 18, 1895.

In an incandescent electric lamp, the combination with a bulb, of leading-in wires passing through and sealed in the walls thereof and channels or recesses made in the wall of the bulb, in which channels or recesses the outer ends of the leading-in wires are disposed.

Miscellaneous:—

Combination Circuit Closer and Sprinkler, G. A. Wall, Providence, R. I., 547,825. Filed Feb. 11, 1895.

Apparatus for Placing Electric Cables, E. S. Reid, New York, 547,891. Filed June 18, 1892.

Coupling for Electromotors, F. Marburg, Jr., Buffalo, N. Y., 547,960. Filed May 14, 1895.

Clutch is adapted to operate through centrifugal force generated by the rotation of the armature shaft of the motor, and provided with means for proportioning the force to the speed of the shaft.

Electric Heater, G. H. Whittingham, Baltimore, Md., 547,979. Filed July 15, 1895.

For description see last issue.

Thermo-Electric Generator, H. B. Cox, Hartford, Conn., 548,038. Filed Jan. 31, 1894.

The hard and soft metal of the elements are fused together electrically so that an alloy is formed at the junction.

Railways and Appliances:—

Conduit System for Electric Railways, J. Hartman, Philadelphia, Pa., 547,783. Filed Apr. 7, 1893.

Details of construction.

Supply System for Electric Railways, J. Hartman, Philadelphia, Pa., 547,784. Filed Aug. 7, 1893.

Details relating to a closed conduit system.

Combined Electrical and Mechanical Brake, J. R. Cravath, Chicago, Ill., 547,847. Filed Aug. 10, 1895.

The combination with an electrical brake, operated by a motor rotated by the motion of the vehicle, of a mechanical brake, and a single operating lever or handle for first throwing the electrical brake into operation to perform the main work of retarding the car and subsequently throwing the mechanical brake into operation to bring the car to a final standstill.

Switch or Crossover System for Electric Railways, H. M. Brinckerhoff, Chicago, Ill., 547,873. Filed June 13, 1895.

Particularly adapted to electric railways embodying the third or contact rail principle—such, for instance, as used in elevated railway structures.

Series Electric Railway, O. B. Finn, Philadelphia, Pa., 547,914. Filed Mch. 29, 1894.

Details of construction and operation.

Insulator for Trolley Wire Supports, J. W. Meaker, Evanston, Ill., 547,981. Filed Nov. 19, 1894.

Details of construction.

Trolley Wheel, H. Schmidt, Moline, Ill., 548,011. Filed Jan. 5, 1895.

Supply System for Electric Railways, H. V. Brown, Brooklyn, N. Y., 548,032. Filed Nov. 21, 1894.

Vertically shiftable current carriers arranged to be normally out of contact with the main circuit and a catch adapted in one position to restrain and in another position to release said carriers, and an electro-magnet arranged to actuate said catch and being momentarily electrically connected with the next preceding current carrier.

Electric Railway System, J. La Burt, Brooklyn, N. Y., 548,070. Filed June 26, 1894.

For description see THE ELECTRICAL ENGINEER, Oct. 2, 1895.

Trolley Rope and Pole Controller, O. A. Lord, San Francisco, Cal., 548,074. Filed Jan. 9, 1893.

A trolley rope with a tension device to which one end of it is connected, which device, while it will not permit the rope to unwind or slacken under ordinary conditions, will yield sufficiently to allow for fluctuations.

Telephones :—

Telephone System and Cable, J. W. Marsh, Pittsburgh, Pa., 547,960. Filed May 6, 1895.

The direct conductors are grouped in pairs, insulated and twisted together, and the common metallic return consists of one or more pairs of insulated twisted wires instead of a large bare wire. Adapted to be readily converted from a ground return to a metallic circuit cable.

Telephone Attachment, C. H. Bernard, Cleveland, Ohio, 548,037. Filed Mch. 15, 1894.

Provides a telephone with means whereby the instrument shall be in electrical connection with the central office when the receiver is taken from the switch or fork and hangs suspended, so that central can still ring.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED OCT. 22, 1895.

Alarms and Signals :—

Non-Interference Signal Box, W. H. Kirnan, Bayonne, N. J., 548,317. Filed Dec. 1, 1892.

Railway Signaling, J. P. Coleman, Swissvale, Pa., 548,436. Filed May 28, 1895.

Electric Block Signaling Instrument for Railways, A. C. Fraser, Brooklyn, N. Y., 548,436. Filed Mch. 26, 1895.

Automatic Block System, J. Shoecraft, Harveyville, Kan., 548,469. Filed Mch. 27, 1895.

Distribution :—

Method of and Apparatus for Rectifying Alternating Currents, J. E. Neher, Pittsburgh, Pa., 548,217. Filed Aug. 7, 1893.

Employs a choking coil.

Method of Converting or Transforming Periodic Electric Currents to Obtain Constant Effective Intensity of Voltage, P. Boucherot, Paris, France, 548,511. Filed Dec. 10, 1892.

Consists in combining in series in the circuit of constant electromotive force, a capacity and a self induction and connecting the circuit in which the constant effective intensity is required in shunt with either of these two apparatuses.

Dynamos and Motors :—

Electric Motor, I. E. Storey, Hornellsville, N. Y., 548,401. Filed Jan. 28, 1893.

An electric motor having two field magnet coils and a rotary armature, one of said coils surrounding the other and both coils surrounding the armature.

Electric Motor, I. E. Storey, Hornellsville, N. Y., 548,402. Filed Jan. 28, 1893.

Consists of a hollow body or shell made in two closed cup-shaped parts, secured together and enclosing a single field magnet coil and an armature whose working faces are at right angles to its shaft.

Dynamo-Electric Machine, E. Thomson, Swampscott, Mass., 548,406. Filed Mch. 29, 1895.

A dynamo-electric machine having a stationary armature provided with independent windings overlapping in sets, the sets not overlapping each other, and separate circuits extending from each independent winding.

Electrometallurgy :—

Magnetic Ore Separator, C. G. Buchanan, Brooklyn, N. Y., 548,176. Filed Feb. 13, 1895.

Belongs to that class in which the crushed ores are fed by gravity upon a drum which rotates around relatively stationary magnets located in its interior.

Hydrostatic Electric Amalgamator, J. D. McKinnon, Portland, Ore., 548,265. Filed Dec. 14, 1894.

Magnetic Separator, J. D. McKinnon, Portland, Ore., 548,353. Filed Apl. 16, 1895.

Improvement on inventor's previous patent No. 519,969.

Amalgamator, A. C. Rumble, San Francisco, Cal., 548,595. Filed Jan. 31, 1895.

Novel construction and combination of parts.

Galvanic Batteries :—

Dry Battery, F. M. Archer, New York, 548,415. Filed Dec. 15, 1890.

In a dry electric battery a containing case which can be opened in combination with an absorbent separating the positive and negative elements.

Lamps and Appurtenances :—

Electric Desk Light, W. R. Kinsman, Arlington, N. J., 548,369. Filed Oct. 14, 1893.

The lamp is horizontally arranged within a cylindrical casing and having its socket inserted through an aperture.

Electric Arc Lamp, T. E. Adams, Cleveland, Ohio, 548,413. Filed July 8, 1895.

Details relating to patent below.

Electric Arc Lamp, T. E. Adams, Cleveland, Ohio, 548,414. Filed July 10, 1895.

The "A-B" Arc Lamp illustrated in THE ELECTRICAL ENGINEER, Oct. 16, 1895. Details of construction.

Phosphorescent Electric Lamp, D. McF. Moore, New York, 548,574. Filed Jan. 3, 1895.

Modification of system of same inventor described in last issue.

Lighting Systems :—

Phosphorescent Electric Light Condenser and Accumulator, D. McF. Moore, New York, 548,575. Filed Jan 24, 1895.

Phosphorescent Electric Lighting by Interruptions, D. McF. Moore, New York, 548,576. Filed Jan. 24, 1895.

This and preceding patent are modifications of same inventor's electric lighting system described in our last issue.

Measurement :—

Method of and Means for Temperature Adjustment for Inductance for Inductive Coils, O. B. Shallenberger, Rochester, Pa., 548,230. Filed Apr. 15, 1895.

An inductance coil provided with a core having air gaps and an expansion bar for automatically varying the dimensions of such air gaps in accordance with changes in temperature. Intended for measuring purposes.

Phase Adjustment, O. B. Shallenberger, Rochester, Pa., 548,231. Filed Apr. 15, 1895.

The combination with a field coil, of an inductive resistance in series therewith, a secondary field coil, an auxiliary coil having a magnetic circuit substantially coincident with that of said first-named field coil, and a closed circuit armature in inductive relation to the three coils.

Electric Metering Apparatus, W. S. Barstow, Brooklyn, N. Y., 548,419. Filed Apr. 6, 1895.

A meter adapted to register at different rates during different times of the day.

Electric Meter, W. H. Scott, Norwich, Eng., 548,467. Filed Nov. 4, 1892.

Has an electrodynamometer provided with conductors in series and in shunt, one of the conductors being movable in combination with means for periodically making and breaking the shunt circuit, whereby the moving conductor is made to move periodically an amount in proportion to the watts or amperes multiplied by volts in the circuit.

Miscellaneous :—

Electric Stop Mechanism, W. M. Wood and J. C. Miller, Elmira, N. Y., 548,280. Filed June 7, 1894.

Designed to stop the engine and short circuit the electric generator.

Electromechanical Lock, W. W. Alexander, Kansas City, Mo., 548,282. Filed Nov. 15, 1889.

Cable Hanger or Clip, W. P. Crockett, Boston, Mass., 548,297. Filed May 15, 1895.

Electric Cigar-Lighter, F. W. Schindler-Jenny, Kennelbach, Austria-Hungary, 548,396. Filed Feb. 19, 1894.

Details of construction.

Igniting Device, W. White, Brunswick, Australia, 548,498. Filed Feb. 5, 1895.

Apparatus for lighting and extinguishing gas street lamps. Effected by increasing the gas pressure momentarily at the gas works. This operates an igniting and extinguishing device at each lamp.

Electric Stop-Motion for Engines, L. St. Peter, Springfield, Mass., 548,580. Filed March 1, 1895.

Railways and Appliances :—

Magnetic Brake, O. S. Walker, Worcester, Mass., 548,331. Filed Feb. 20 1895.

Electric Locomotive, W. H. Knight, New York, 548,371. Filed June 15, 1888.

Relates to a method of motor suspension.

Three Wire Electric Railway, W. B. Potter, Schenectady, N. Y., 548,389. Filed Aug. 8, 1895.

A three wire electric railway system composed of two dynamos in series, a track or ground return forming one side of the system, and metallic conductors forming the neutral and the other side of the system.

Underground Conduit for Electric Railroads, R. Uren, Hancock, Mich., 548,481. Filed May 10, 1894.

An open insulating conduit partly filled with water having a stratum of oil superimposed upon the water and a conductor located in the conduit and surrounded by the water.

Combined Electric and Cable Railway, G. E. Beach & M. J. Kern, San Francisco, Cal., 548,504. Filed Aug. 1, 1892.

A haulage cable is provided at grades, driven by a motor connected to the railway circuit.

Electromagnetic Brake, J. L. Black, St. Louis, Mo., 548,509. Filed May 9, 1894.

An electro magnet having an unobstructed central opening, and two separate cores, arranged within the opening in the magnet and connected to the brake mechanism.

Electromagnetic Brake, J. L. Black, St. Louis, Mo., 548,510. Filed Apl. 12, 1895.

Underground Conduit System, H. C. Burk, Cleveland, O., 548,514. Filed Feb. 28, 1893.

Means for electrically connecting the trolley depending from the car with the line wire at the time of passing, while otherwise withdrawing the line wire from possible contact with moisture or exposure to outside influence.

Electric Street Car Controller, G. Valley, Cleveland, Ohio, 548,599. Filed Dec. 5, 1894.

Novel features of construction, combination and arrangement.

Regulation :—

Regulating Electric Motors, W. B. Potter, Schenectady, N. Y., 548,388. Filed July 22, 1895.

The art of operating electric motors upon a three wire series multiple electric railway, which consists in running upon each car an equal number of motors upon each side of the system, and making similar changes or steps in the control of each side.

Regulator for Alternating Currents, C. P. Steinmetz, Schenectady, N. Y., 548,400. Filed April 18, 1895.

Consists in varying the path of the magnetic lines of force passing between stationary coils in inductive relation, part of the coils being in series in the main circuit, the remainder in shunt.

Controller for Electric Motors, D. J. McLane & G. W. McClintock, Quincy, Mass., 548,448. Filed May 25, 1895.

Details of construction.

Switches, Cut-Outs, etc. :—

Automatic Switch for Electric Transformers, A. G. New, London, A. J. Mayne, Working, Eng. & R. N. Lucas, Galway, Ireland, 548,266. Filed June 25, 1894.

Means for causing the primary to be cut out automatically when the secondary is broken and to become connected again with the high tension mains, also automatically, when the secondary circuit is closed.

Electric Snap Switch, J. H. McEvoy, Waterbury, Conn., 548,583. Filed Feb. 18, 1893.

Details of construction.

Electric Switch, J. L. Black, St. Louis, Mo., 548,601. Filed April 13, 1895.

A device for operating switches by means of electro magnets.

Telephones :—

Telephone Receiver Support, I. J. Kusel, St. Louis, Mo., 548,210. Filed Feb. 18, 1895.

Telephone Exchange Apparatus, C. E. Scribner, Chicago, Ill., 548,227. Filed Mch. 5, 1894.

Provides mechanism for opening the normally-closed bridge in which the operating coil of the individual annunciator is included and adapted to be actuated by current in a local circuit arranged to be closed when connection is made to the line.

Apparatus for Telephone Switchboards, C. E. Scribner, Chicago, Ill., 548,228. Filed Feb. 28, 1895.

The combination with a telephone line, of a relay included in the line circuit, a local circuit including a source of current and a subsidiary signal, controlled by the relay, and means for short circuiting the said signal when connection is made with the line.

Keyboard Apparatus for Telephone Switchboards, C. E. Scribner, Chicago, Ill., 548,229. Filed Feb. 7, 1893.

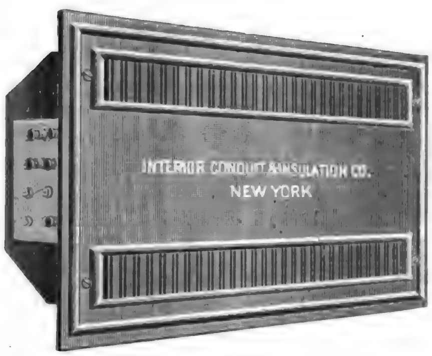
Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

NEW ELECTRIC CAR HEATER OF THE INTERIOR CONDUIT AND INSULATION CO.

THE Interior Conduit and Insulation Company of New York have introduced this season an electric car heater, which embodies a number of improvements in this class of apparatus. All the electric energy absorbed by an electric heater is converted into heat. But it is not sufficient merely to create heat, but also to utilize it to the best advantage, and in order to do this, it is imperative that the heat should be distributed and circulated where it is needed, and as fast as it is generated.

In the heater manufactured by the Interior Conduit and Insulation Company, shown in the accompanying engraving, a con-



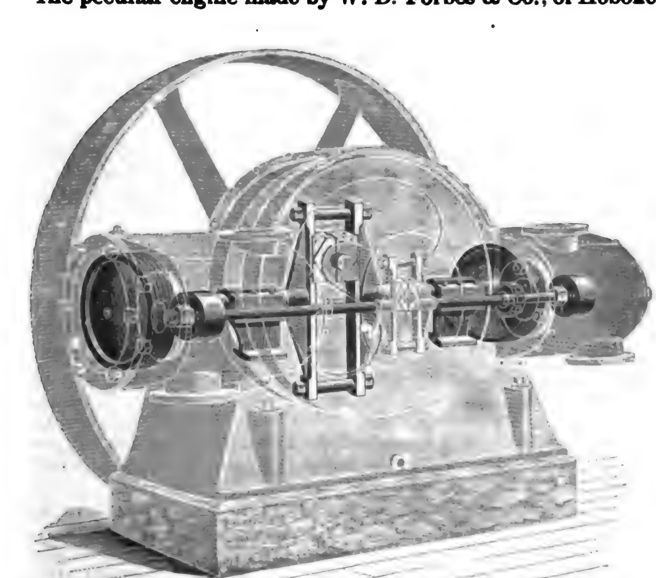
ELECTRIC CAR HEATER OF THE INTERIOR CONDUIT AND INSULATION CO.

tinual circulation of air is maintained. All the air passes through the coils, and all the heat generated is carried off and distributed into the body of the car, the case of the heater remaining perfectly cool. There is no waste, and consequently a much higher degree of efficiency is obtained. These heaters are thoroughly well made, neat in appearance, easily installed, and are amply guaranteed.

FORBES HIGH SPEED ELECTRIC LIGHT ENGINE.

With the constant threatened danger of being wiped out of existence, the reciprocating engine seems still to find adherents bold enough to go on refining it and building it; and the engine buying public still buy.

The peculiar engine made by W. D. Forbes & Co., of Hoboken,



THE FORBES ELECTRIC LIGHT ENGINE.

N. J., illustrated above, aims at reducing and simplifying all parts, and at the same time producing an engine of close regulation coupled with smooth running.

The valves are of the piston type and governed by an automatic governor, which does not show in the engraving. The balance of the engine has been very carefully studied and can be made proper for any speed up to about 450 turns. All parts of the engine are made with great care and the builders believe that a large sale will follow the introduction of their engine, which is, to say the least, quite a departure from usual practice.

MORE SPRAGUE ELEVATORS GOING IN.

THE SPRAGUE ELECTRIC ELEVATOR COMPANY have been awarded the contracts for elevators in the following buildings: Manhattan Hotel, H. J. Hardenbergh, architect, 42d street and Madison avenue, eight elevators; Canada Life Insurance Company's Building, Montreal, R. A. Waite, Buffalo, N. Y., architect, two elevators; Mabley Building, Detroit, Mich., Burnham & Root, Chicago, Ill., architects, ten elevators; new Commercial Cable Building, Broad street, New York, Harding & Gooch, architects, six elevators; and the Young Men's Christian Association building (Parish & Schroeder, architects) on West 57th street, where three elevators will be installed.

The wide geographical distribution of these elevator contracts is suggestive. A year ago it was necessary to travel hundreds of miles to see one of these machines in operation; before long they will be found in all the large cities of the Union.

THE LUNKENHEIMER "SENTINEL" GLASS OIL CUP.

THE Lunkenheimer "Sentinel" snap lever sight-feed glass, illustrated in the accompanying engraving and manufactured by the Lunkenheimer Company, of Cincinnati, New York and London, is of strong and substantial construction, besides being simple in operation, compact, and not liable to get out of order. It dispenses with complicated lock-nut feed regulating devices, and uses a simple arrangement by means of which the feed is easily and securely adjusted. The cup is guaranteed to withstand the heaviest jarring of machinery. The feed does not unset with either the raising or lowering of the lever, as the curved spring which presses against the milled regulating nut prevents it from from turning. When set to feed a given amount of oil, it holds up the rate of feed until the cup is emptied.

WESTON INSTRUMENT CATALOGUE.

The familiar expression "It's a good thing, push it along!" applies aptly to the Biddle catalogue of Weston instruments, if anything can be judged from the large number of inquiries for it that have been received. In preparing this catalogue Mr. Biddle had made a particular point of presenting in the most concise form a complete price list of all portable and switchboard instruments regularly made by the Weston Electrical Instrument Company, and in addition shows cuts and templates of the several forms, to assist both purchasers and users of the apparatus.

Still more interesting perhaps, is a chapter devoted to the measurement of resistance and insulation, with the Weston voltmeter, ammeter and milli-voltmeter, presenting formulas and data of great value.

The supply of these catalogues (No. X) is rather limited, so that parties who desire to secure copies, would do well to communicate at once with James G. Biddle, 528 Drexel Building, Philadelphia.

THE EDDY GENERATOR AND MOTOR BOOM.

Among the recent installations of the Eddy Electric Mfg. Company are the following: 1000 light M. P. generator, Pope Mfg. Co., Hartford; 60 K. W. M. P. generator, Great Kanawha Colliery Co., Mt. Carbon, W. Va.; two 500 light M. P. generators, Jas. Lee's Sons & Co., Bridgeport, Pa.; two 50 K. W. direct connected generators, J. B. Van Sciver & Co., Camden, N. J.; 65 K. W. direct connected, J. N. Adam & Co., Buffalo; 40 K. W. lighting generator, Augustus Noll, New York; 30 K. W. direct connected generator, O. Wiederhold, Newark, N. J.; 11 K. W. lighting generator, Boyden Lumber Co., Neelyville, Mo.; 25 K. W. direct connected generator, Bethlehem Silk Co., Bethlehem, Pa.; 40 K. W. generator, Henry R. Worthington, Elizabethport, N. J.; two 60 K. W. and one 40 K. W. generators and one 50 H. P. and two 10 H. P. motors, Wm. Campbell & Co., New York; 40 K. W. M. P. lighting generator, Eagle Bicycle Mfg. Co., Torrington; 20 K. W. lighting generator, Excelsior Needle Co., Torrington, Conn.; two 50 K. W. direct connected generators, National Theatre, Philadelphia.

EDISON-BROWN PLASTIC BOND FOR THE BUFFALO RAILWAY.

The Buffalo Railway Co. has put down an insulated feeder, 1,500 feet long, composed of four lengths in parallel of old high-carbon steel, tram rails, weighing about 50 lbs. to the yard. These are connected together with the Edison-Brown plastic rail bond and are carrying 1,100 amperes with a drop of but 4 volts. This remarkable performance shows that the plastic bond actually gives an electrically continuous rail. Another conduit 1,800 feet long with 14 similar rails in parallel is now being laid. The rails are worth little or nothing as scrap on account of their high carbon and the insulation is secured by inclosing them in a strong wooden trough and filling the space with a cheap insulating compound made from the refuse of petroleum distillation. The work is done under the supervision of Harold P. Brown, of New York, and forms part of his system of electrolysis prevention which has been adopted at Buffalo.

HANNE BROS.' ADJUSTABLE COMBINATION WIRE REELS.

The wire reels of Hanne Bros., of 1,302, 1,304 and 1,306 W. Adams Street, Jacksonville, Fla., which are being exhibited at the Atlanta Exposition, embrace a very comprehensive list, including reels for telegraph, telephone, electric street car, and construction companies, electrical supply houses and hardware stores. The trouble that handlers of wire have always found in the old time reels from kinking and twisting is entirely banished by the effective appliances which Hanne Bros. have put on the market, the use of which also effects a large saving in time.

Their Little Giant reel has been manufactured especially for the construction of telephone, telegraph and electric street car lines. Coils of wire weighing as much as 400 pounds can be placed in perfect position, on short notice, with ease. The engraving, Fig.

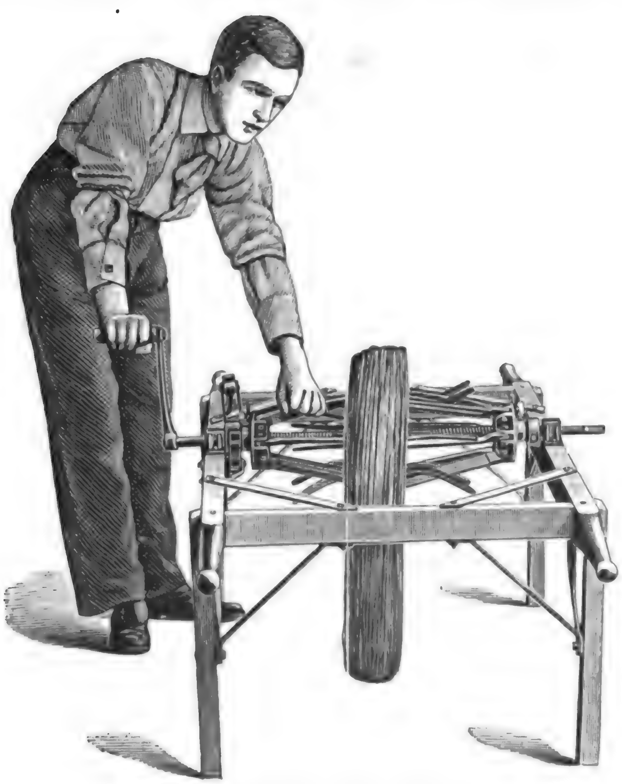


Fig. 1.—Hanne Wire Reel.

1, shows a lineman with reel, about to crank up the reel. The great advantage over other reels is that the wire comes off as it is put up at the factory, without a kink or a spiral. It is an adjustable combination reel, because any size coil of wire can be taken up or paid out at will; thus it proves an immense time-saver.

The accompanying view, Fig. 2, shows a coil of wire held in position. The best results in paying out are gained by letting the wire run underneath the frame. The thin, narrow fingers which hold the wire in position, are made of the best malleable iron. The fingers, axle and wooden frame are strong enough to hold up from six to eight hundred pounds. Any broken part of the reel will be replaced by the company free of cost. The reel hugs snugly to any size coil of wire with inside diameter from 7 to 26 inches.

The "Gem Reel," Fig. 3, is a small reel for the handling and retailing of wire. It works on the same principle as the "Little

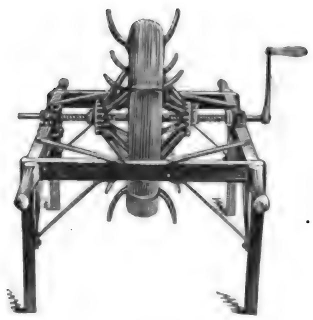


Fig. 2.

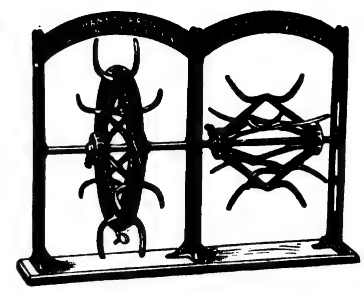


Fig. 3.

Giant," with the difference that the hubs slide on smooth shafts and are locked to them by thumbscrews.

Hanne Bros. exhibit many other forms of reel, which have been highly commended by the trade.

ADVERTISERS' HINTS.

Another Lamp Test is shown this time by the Westinghouse Co. and the result is one to be proud of. Any voltage, any candlepower, ornamental or plain—they have them all.

Mr. Harold P. Brown is advertising the merits of the "Plastic" Rail Bond. He has received many letters endorsing this method of stopping electrolysis.

"Man Wants but Little Here Below" is an old story but the application is new and true, as given by the Central Electric Co.

The India Rubber & Gutta Percha Insulating Co. refer to their work on insulation. It's a big book and they fill it well.

Storage Batteries in Telegraph Service. Under this heading the Electric Storage Battery Co. submit some statistics which are well worth studying if you are interested in Telegraphy.

Mr. James G. Biddle will send his most recent catalogue of Weston instruments on application. It will be remembered he represents also Elliott Bros., of London, in the U. S.

Telephone Supplies are quoted at very low prices by the Farr Telephone & Construction Supply Co. Their specialty is transmitters.

WESTERN NOTES

Mr. S. G. Booker, manager of the Phœnix Carbon Mfg. Co., St. Louis, made a business trip to Chicago, a few days ago.

Mr. Wells Goodhue, 1564, the Monadnock Block, Chicago, has been appointed General Western Agent for the Phœnix Carbon Mfg. Co., St. Louis.

The Adams-Bagnall Electric Co., of Cleveland, O. (47 East Prospect street) have issued a very neat, tasteful and effective catalogue of their new "A-B" incandescent lamp, described in our columns last week. It is pithy and well put together, and does justice to the lamp, which has many new points of merit.

NEW YORK NOTES.

Mr. Wm. Stanley, Jr., of the Stanley Electric Mfg. Co., was in New York last week for business and to attend the meeting of the Institute.

President J. H. Rhotehamel of the Columbia Incandescent Lamp Co., of St. Louis, was a welcome visitor to New York last week, en route for home from Montreal. Mr. Rhotehamel is doing a public service by his efforts to keep up lamp quality and lamp prices, and his daily order sheets show that he is anything but a sufferer as the result.

The Smith-Vassar Telephone Co. has been formed to manufacture telephone and telegraph instruments and apparatus and electrical devices in New York City; capital, $1,000,000. Directors, W. L. Beardsley, Frederick J. Winster, Joseph F. Darling, Augustus N. Hand, Charles W. Dorland and Edward Schmidt, of New York City, and Frank S. Pusey, of Council Bluffs.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE

Electrical Engineer.

Vol. XX. NOVEMBER 6, 1895. No. 392.

STORAGE BATTERIES IN OFFICE BUILDINGS.

BY

AMONG the owners and superintendents of office buildings operating electric lighting plants, the use of storage batteries as auxiliaries to their dynamos is a subject that is receiving well deserved attention. The adoption of such a combination results in an improved service at an increased economy of production. For years practical men have realized the advantages to be derived from the use of storage batteries as adjuncts to electric lighting plants. That the very large majority of office buildings are not now so equipped may be attributed to patent litigation and to the fact that until recent years, the types of batteries on the market did not possess sufficient durability and efficiency to warrant their installation. Since the introduction of a battery free from the defects of earlier forms and beyond all claims of infringement, a large number of plants have been put down, and their satisfactory operation, as to service, economy and convenience indicates the very general adoption of the auxiliary battery system. In the large proportion of office buildings, storage batteries would prove a very profitable investment—in many instances the saving to be effected by their use would amount to from 25 to 60 per cent. per annum on their first cost.

In many office building plants, the dynamos are not of such capacities as to run efficiently under the minimum, the average and the maximum loads, each of which generally holds for several hours a day.

The fact that fuel per horse power hour increases as the demand on the plant decreases, other operating expenses generally being fixed independently of the load, renders the operation of an engine during periods of light load very wasteful.

The following table[1] gives the coal consumption of a non-condensing Willans engine under various conditions of load:

Engine Load Factor.	Pounds of Coal Consumed per Unit.
20	7.8
30	5.4
40	4.75
50	4.3
60	4.
70	3.75
80	3.5
90	3.4
100	3.3

While the coal consumption quoted may not correspond closely with the results usually obtained in office building plants, the figures point out clearly the loss at which many of the generating plants are being operated. They also indicate that energy taken from a dynamo driven by an engine (that would otherwise run greatly below its normal load) and stored in a battery, can be produced without a proportionate increase in coal consumption. It is a fact that there are office building plants operating storage batteries to carry the night load and also the light day load that consume no more coal now than before the batteries were installed. Under the conditions usually met with in the class of buildings mentioned, the lamp load is at or near its maximum for but two to three hours, and during the remainder of the day, eight to nine hours, is generally much below the capacity of the dynamo in use. After the plant has been shut down at night, the comparatively few lights required in the halls

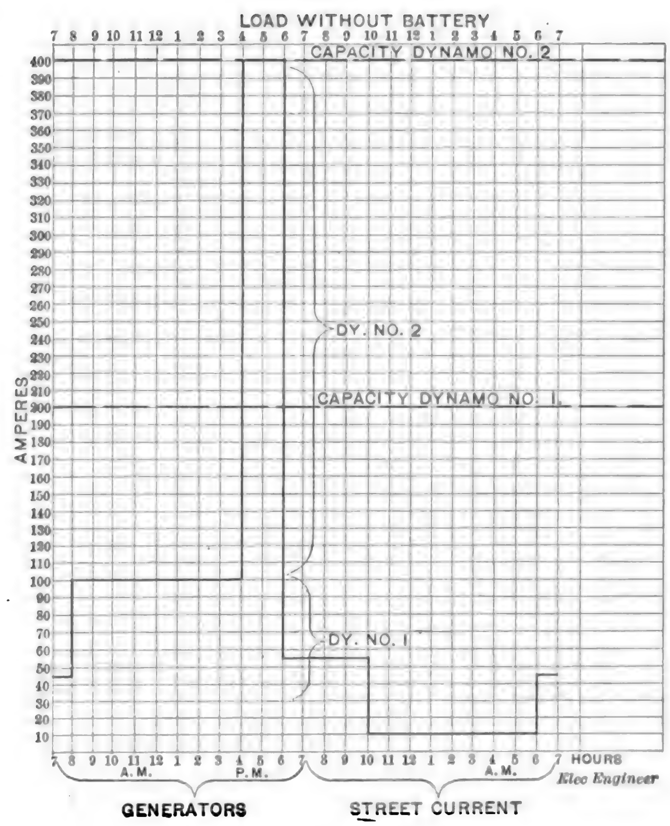


FIG. 1.

and by the tenants, the janitor and the watchman, are usually supplied by gas or by connection with the street service. The cost of this night light is very greatly in excess of what it would be were it furnished by current from a battery charged during the periods of light load during the day. While the conditions regulating the lighting service are seldom identical in any two office buildings, the same general outlines or characteristics apply to them all.

The following data covering the lighting service in a bank and office building, will serve to emphasize some of the advantages to be derived from the use of storage batteries.

The generating plant consists of one 200 ampere (No. 1)

1. From paper read before the Northern Society of Electrical Engineers, Manchester, May 13, 1895, by J. C. Howell.

dynamo and one 400 ampere (No. 2) dynamo, direct-connected to non-condensing engines. The plant is run from 7 A. M. to 7 P. M. furnishing current at a pressure of 115 volts at the switchboard for a load as follows:

7 A. M. to 8 A. M. .... 45 amperes.
8 A. M. to 4 P. M. .... 100 "
4 P. M. to 6 P. M. .... 400 "
6 P. M. to 7 P. M. .... 55 "

After 7 P. M. street current supplies the light required by late tenants, janitor, watchman, etc., as follows:

7 P. M. to 10 P. M. .... 55 amperes.
10 P. M. to 6 A. M. .... 10 "
6 A. M. to 7 A. M. .... 45 "

Fig. 1 shows the load curve for 24 hours. Dynamo No. 2 is in service for two hours per day and at full load. Dynamo No. 1 running 10 hours produces but 1,800 lamp hours. Were it run to its safe limit, it would furnish without

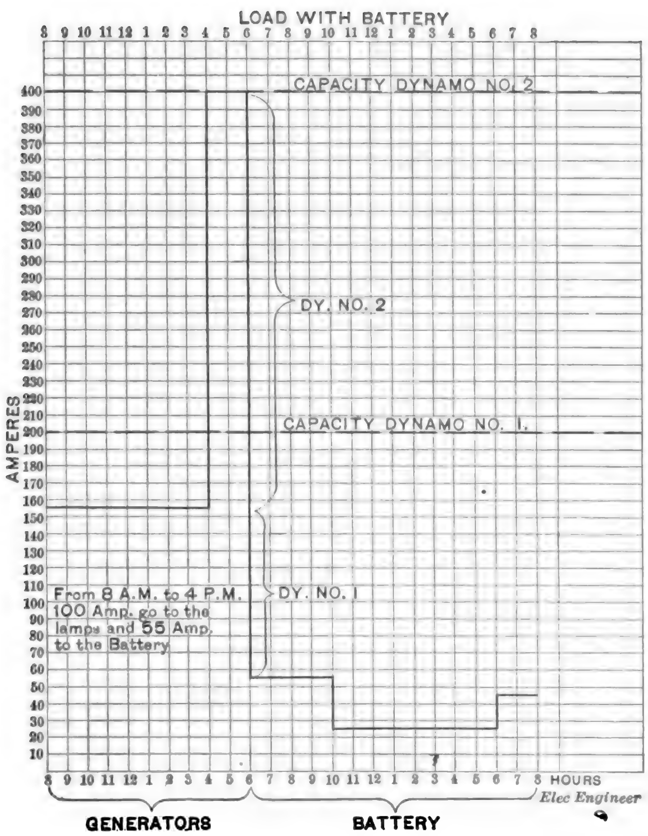


FIG. 2.

additional expense, except slight increase in coal bill, 3,600 lamp hours.

The following estimate of coal consumed is based upon Mr. Howell's figures as quoted above.

	Dynamo load.	Dynamo.	Load factor.	H. P. hrs.	Lbs. of Coal per H. P. hour.	Total lbs. of Coal consumed.
7 A. M. to 8 A. M. ..	45 amp.	No. 1	25	7	6.2	43.4
8 A. M. to 4 P. M. .	100 "	" 1	50	123.2	4.3	529.8
4 P. M. to 6 P. M. ...	400 "	" 2	100	123.2	3.3	406.6
6 P. M. to 7 P. M. ...	55 "	" 1	25	8.5	6.2	52.7
Total..						1032.5

A battery installed to meet these conditions would cost approximately $3,000. It would supply the current required from 6 P. M. to 8 A. M., reducing the running time of the generators by two hours. To charge the battery, a current of 55 amperes, at an average of 150 volts, should be passed through it for 8 hours, or from 8 A. M. to 4 P. M.

Fig. 2 gives the load curve for 24 hours with the battery under charge and discharge.

With the additional power to charge the battery, the coal consumption is as follows:

	Dynamo Load.	Dynamo.	Load Factor.	H. P. Hours.	Pounds of Coal per H. P. hr.	Total Pounds of Coal Consumed.
8 A. M. to 4 P. M.	100 amp. at 115 volts for lamps. .... 55 amp. at 150 volts for battery	No. 1	85	212.	3.45	731.4
4 P. M. to 6 P. M.	400 amp. at 115 volts for lamps...........	No. 2	100	123.2	3.3	406.6
						1,138.0

The saving to be effected by the operation of the battery can now be figured as follows:

Saving of cost of street current, 580 lamp hours per night, 300 nights per year at .0085c. net.................. $1,479.00
Increased coal consumption for charging battery 105.5 lbs. per day, 300 days per year, at $3.25 per ton.............................. $51.43
Depreciation at 7½ per cent..................... 225 00
276 43

Net saving..................................$1,202.57

Or, 40 per cent. on the first cost of the plant, in addition to the saving in labor, oil, waste and depreciation of machinery effected by reducing the running time by two hours per day.

From the example quoted, it may be noted that the installation of a battery may produce these results: During the periods of light lamp load, the charging of the battery operates the plant at an increased efficiency; the running time of the machinery is reduced, lessening depreciation and in some instances doing away with one shift of men; the battery furnishes the light required after the dynamos have been shut down, saving expense of gas or street current; it is an element of safety, as, in case of a breakdown of the generating plant, the battery will maintain three to four times its rated number of lamps for a short period; if the maximum load becomes too heavy for the generators, the battery will furnish a portion of the current required.

The addition of a battery to a plant already in operation, produces the advantages mentioned above, while a battery included in the original design of a plant permits of the installation of generators of a capacity sufficient to take care of only about the average load, the battery being used to assist during the hours of maximum load.

It is a demonstrated fact that a storage battery operated in connection with a generator, reduces the cost of producing energy to meet a variable demand. Batteries are therefore particularly applicable to office buildings operating electric elevators. The power required to start an elevator is from one and one-half to three times that necessary to hoist. Unless a battery be used, the capacity of the generating plant must be great enough to meet the maximum demand which exists for but a small fraction of the running time. With a battery, the capacity of the generators may be reduced to about the average demand and run at full load and maximum efficiency continuously, charging the battery during periods when the demand drops below the average and being assisted by the battery during periods of maximum demand. This system also protects the dynamos and engines from the heavy strain of the sudden and excessive starting load.

The value of the system has been shown in a plant in the

West where the load on the dynamos fluctuated between extremes of 0 and 150 amperes. Since the installation of a battery, a dynamo has been run steadily at 38 amperes, the battery automatically absorbing energy under light load and delivering it under heavy load.

A battery operated in elevator service, in addition to supplying current for night lights, will furnish power to run a car after the generating plant has been shut down. This is a great convenience in lofty office buildings. A battery is not a complicated apparatus, and does not require any special knowledge of electricity on the part of the man handling it. It should have a certain amount of supervision daily, but the attention required is so slight as to entail no increase in cost of labor. As an example of the space occupied by a battery, a 100-light plant could be set up in a room 10 x 8 with 5 feet head-room.

Much of what has been stated here concerning the use of storage batteries in office buildings, will also apply to their application to residences, hotels, mills, factories, etc. Broadly stated, storage batteries may be profitably operated wherever a direct current generator is called upon to furnish power to meet a variable demand, where light or power is required after the generating plant has been shut down or where the maximum demand exceeds the capacity of the generator.

ROUNDABOUT NOTES IN ELECTRICAL EUROPE—VI.

BY

E. J. Wessels.

PARIS.

EVERYONE knows of Paris, one of the most beautiful cities in Europe. Here, indeed, one finds the latest developments in all lines, from the necessaries to the luxuries of life. But while one may obtain almost everything that can be asked, in the magnificent shops which line avenues and boulevards, one looks in vain for electric cars operated by the overhead contact. The only approach to electric traction here is the accumulator system. This is employed on one of the lines, but it is not practicable to obtain figures showing the advantage or disadvantage attending it. The average resident knows nothing of it.[1] The accumulator cars make fair speed and run well enough, but the question of weight of batteries and disintegration can only be answered by those in authority. Efforts have been made for years to introduce the overhead system, but all overtures have been resisted, so that those who have tried the hardest, at last begin to despair of success. The congestion of traffic is by no means as great here as in London, as noted in my last article, and it would be entirely feasible to introduce the overhead system; cars so operated would be infinitely preferable to the many filthy fiacres, on which one must depend if speed be an object. Compressed air is used on a number of cars, but it is true of this, as of the accumulator cars, that one cannot obtain reliable data of cost of operation, etc. The compressed air cars require to be charged from a central station, and it is asserted that the pressure carried on the cars is something enormous. It is, however, exceedingly difficult to ascertain even this point, as the drivers seem to be automatons and cannot tell anything about the pressure which they handle every day.

This city is the headquarters of the Compagnie General Francaise Thomson-Houston. In its office several Americans who served their apprenticeship at Lynn and elsewhere will be found. As is known to some of your readers, this progressive Company has inaugurated work in the most important cities of France. It is to be hoped that when the Parisians become familiar with the results obtained in Havre, Lyons, Bordeaux and elsewhere, they will, through their authorities, consent to the introduction in Paris of the overhead system. The boulevards are so wide that the erection of graceful poles would not mar the beauty of the city. Even the most virulent opponent of the overhead system must freely admit that the worst form of overhead construction cannot mar the streets anything like as much as the filthy half-protected urinals do, which offend the eyes wherever one goes.

BY WAY OF CONCLUSION.

In bringing to a close the papers which I have been submitting for several weeks, it may be well to point out a few features, in the hope that they may be of service to the subscribers to THE ELECTRICAL ENGINEER.

It seems almost needless to state that in such a hurried trip as I made abroad, visiting thirty-two cities in fifty-four days, it was impossible to go into elaborate details. It would take a long time to do justice to the electrical situation in any of the great centres of Europe. I have therefore been obliged to deal more or less with "generalities." Mine it has been to put together the *skeleton* and the reader must invest it with flesh.

It was gratifying to notice that there were very few things in use on electric roads abroad which can be employed advantageously here. This may seem like undue praise of our American manufacturers, but I believe it to be true, and for corroboration need only mention the fact that the eyes of Europeans are constantly turned towards America and that they watch developments here with eager interest. Some of them have their "pickets" in our shops and on our roads and thus are kept advised on our practice.

In the offices or homes of the important men in the electrical and street railway field abroad will be found bound volumes of the *Street Railway Journal*, THE ELECTRICAL ENGINEER, *The Electrical World* and others.

Several prominent officials informed me they took these papers home so they would not miss any of the contents. They regretted that business pressure prevented them from reading them in their offices. Those who couldn't read English had the principal articles translated.

In Europe, representative men award the palm for progressiveness in the art, to us here. These gentlemen are ready therefore to adopt anything we have which proves practicable for their use. There are difficulties in the way of building up foreign trade, but they are not insurmountable. It may be stated that correspondence should be conducted exclusively in the language of the country with which business is desired. In numerous places in Germany a letter written in English would not receive attention, while if it were written in German, it *might* lead to business.

To develop trade, it is essential that American houses should "keep everlastingly at it." They should send their literature to the various roads and open correspondence, calling attention to anything new.

If the article be of real merit and adaptability, it is not likely to be long before a trial order will follow. That trial order may lead to large business.

In view of the heavy duty and freight on many parts of equipment, it is desirable that, as far as possible, apparatus should be shipped "knocked down" and in sections, and sometimes if "unpainted" there will be a decided reduction in tariff.

It will be a wise plan to secure good resident agents who will take pains to keep prospective buyers posted. Their efforts should be supplemented by forwarding literature from America.

Apparatus intended for shipment abroad should certainly be patented. If patented, there is some chance of protection, but if unpatented, the sending of a trial order will only open the door still wider for infringement.

1. Some data on this road was given by Mr. Maurice Barnett in THE ELECTRICAL ENGINEER of Sept. 18.

The future of electric traction in Europe is most promising and bright. Hardly any of the really great cities have been electrified, and when difficulties are overcome and installations demanded, the demand for material will be colossal.

The field is inviting and Americans who are willing to be patient and push their wares persistently may confidently count upon reaping a rich harvest, even though it be somewhat delayed.

If these Roundabout Notes in Electrical Europe but serve to awaken our manufacturers to the importance of cultivating foreign relations, they will not have been prepared in vain. The writer regrets that business pressure and rapid traveling prevented him from doing fuller justice to the subject.

THE "BOOSTER" SYSTEM IN ELECTRIC RAILWAY WORK AT CHESTER, PA.

WHAT is believed to be the first actual installation of the so-called "Booster" system for electric railway work was, some months ago, put into practical and successful operation on the lines of the Chester Traction Co., in Chester, Pa., under the supervision of J. Lester Woodbridge, of the Woodbridge & Turner Engineering Co., the license to use this system having been purchased by the Traction Company, from the owners of the patent covering this system

Two lines were thus equipped, one extending to Darby, eight miles from the power house, and the other to Media, about seven miles from the power house. It became evident from past experience, that in order to handle the heavy Sunday and holiday traffic on these two lines through the summer, in a satisfactory manner, about $20,000 must be expended for additional feed wire, unless some other arrangement were made to maintain the voltage. The company were about to install an additional generator of 400 K. W. capacity, leaving idle two Short generators of 100 and 150 K. W. capacity respectively. It was these two generators that were adapted and connected up as boosters for the two lines above mentioned, and they were so arranged that either can be used as a booster, or, by simply throwing over a switch on the switchboard, in case of emergency, either can be instantly connected up as a generator in multiple with the other machines, the corresponding feeder being at the same time restored to its original connection with the bus bar. Thus the total capacity of the station has not been reduced by the appropriation of these machines, and although their design is not just what it would have been, had they been specially built for the purpose, they are found to do their work satisfactorily, special connections and rheostats having been introduced into the field windings to make their action automatic.

For the information of those who are not thoroughly posted on the subject it might not be amiss to state that the "booster" system consists in the introduction into a feeder, and in series therewith, of an additional electromotive force to compensate for the loss of voltage on said feeder. Usually this is accomplished by a generator whose voltage is made to vary with and adapt itself automatically to the varying loss on the feeder by causing its fields to be excited wholly or partially by the varying current on the feeder.

The installation in Chester proves conclusively, it is said, the advantage of the "booster" system in railway work, its adaptability to electric lighting having been already demonstrated in a number of instances; and whatever may be said regarding its economy for *continuous* use, as a substitute for feed wire, the net efficiency of the above mentioned installation, which is operated only at times when the traffic is excessive, must be conceded at once. The additional coal consumption for operating the booster a few hours a week becomes a matter of minor importance when compared with the interest on the investment saved.

The practical results achieved in Chester in maintaining the voltage on distant portions of the line are very satisfactory. An approximately constant pressure of 500 volts is secured at the Darby terminus, regardless of load, when the "booster" is in operation, the loads on this section varying from zero to 450 amperes; without the "booster," a single car, climbing the Darby hill, has been known to bring the voltage down to 275. At this low voltage it required a current of nearly 170 amperes to operate the car, and speed was very slow. With the "booster" in operation, three cars have been brought up the hill simultaneously and at good speed. Mr. Woodbridge, we may note, is now handling this system as agent for the present owners of the patent.

LITERATURE.

Transformatoren fur Wechselstrome und Drehstrome. Gisbert Kapp. Berlin, Julius Springer. 204 pp. 8¼" by 5¼". Price, $2.80.

While exhaustive treatises have been written on the dynamo, the technical literature of the transformer is comparatively meagre, a fact which is to be deplored in view of the rank which the transformer now occupies in electrical transmission and distribution of all kinds. Mr. Kapp in the present work has sought to fill this gap and we are glad to say succeeded most admirably. Without going too deeply into the mathematical treatment of the subject, he has succeeded in presenting a most admirable exposé of the principles underlying the construction of the transformer and methods for their application and calculation. To this he has added detailed descriptions with sizes and dimensions of the most generally employed transformers, including those of the two and three phase system. The illustrations throughout the work are excellent and will prove of great value to students and designers. We hope that an English edition of this excellent work may soon be forthcoming.

Large Arc Dynamos. By Charles N. Black. Cleveland, O. Brush Electric Co., 1895. Paper. Illus.

This is an extremely able little pamphlet on the subject of large arc dynamos, and embodies in an extended form the paper read by its author before the National Electric Light Association. It deals principally with the big Brush machines with the introduction of which Mr. Black has had so much to do, but is an excellent discussion of the whole subject. The illustrations and particularly the diagrams are admirable, and as a whole the brochure may be highly commended.

"THE HORSELESS AGE" is the name of a bright, clean-looking and interesting monthly, devoted to the motor vehicle industry. Its publisher is Mr. E. P. Ingersoll, a well-known journalist, with headquarters at 157-159 William St., New York. The first issue, that for November, is full of good matter, and may be regarded as a review of the new art as it stands at this moment. There are 56 pages of text and advertisements, and the large variety of articles is profusely illustrated. Mr. Ingersoll, as the pioneer journalist in this field deserves a handsome reward, and makes a strong bid for it. We shall watch his progress with much interest.

MARRIED.

WETZLER—GERSON.

At Delmonico's, Fifth Avenue, on October 30, Mr. Joseph Wetzler, editor and vice-president of THE ELECTRICAL ENGINEER, was married to Pauline, daughter of Mr. Jacob Gerson, of New York. The ceremony was performed by the Rev. Mr. Silverman in the presence of a large gathering of relatives and friends. After the wedding a collation was served in the banqueting hall. The happy pair, who were the recipients of an overwhelming quantity of wedding presents, from all parts of the country and Europe, left in the afternoon for a Southern trip, beginning with the Virginian seashore.

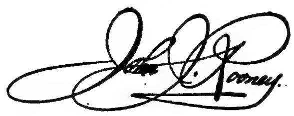
MAXWELL—GOTTLEIB.

Mr. George S. Maxwell, general manager of the Mason Telephone Co., and secretary and general manager of the Southern Electrical Construction Co., was married on October 27, at the Catholic University, Washington, by Bishop Keane, to Miss Rosalie Gottleib, of Richmond, Va. Mr. and Mrs. Maxwell received the congratulations of their friends and then left for a bridal trip to New York and Chicago.

MISCELLANEOUS.

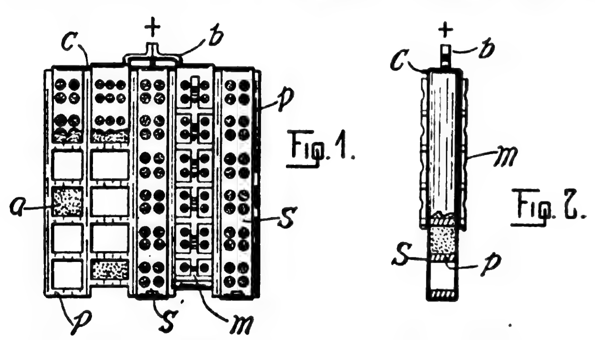
THE ROONEY "LAMELLOSE" OR "TWIN-POLE" PLATE.

BY



IN accumulators in which there is a parallel series of alternate positive and negative electrodes, as in the usual types of Planté and Faure cells, the current passes between adjacent plates at right angles to the plane of each plate. It is evident, therefore, that if any plate bend and touch the other, or particles of conducting material lodge between them, short-circuiting occurs. To minimize such possibilities, the methods employed are to make the plates heavy and rigid, to separate them enough to prevent dislocated material sticking between them, and to interpose sheets of non-conducting substance. I show herewith the plan devised by myself. In this accumulator in which there is also a parallel series of electrodes, the current passes between positive and negative electrodes on the same support and obliquely between adjacent plates. By this construction, short-circuiting from any of the causes previously mentioned is obviated.

As a grid or support for the active materials, some porous, non-conducting substance provided with perforations or receptacles arranged in parallel rows is used. Alternate rows of perforations are filled with active material, as red lead, and the intermediate rows with spongy lead or litharge as the active material. Perforated lead strips each in contact with all the pellets in one row, serve as conductors for the current. A plate of such construction is referred to as a lamellose electrode, or plate, such an electrode being laminated or composed of smaller electrodes, which, with respect to their functions, are consecutively of opposing polarities. Figs. 1 and 2 are respectively side and sectional views of this



FIGS. 1 AND 2.—THE ROONEY LAMELLOSE ELECTRODE.

plate. It will be seen in Fig. 1 that alternate rows are longer than the others, which results, when the plate is in the jar, in leaving the opposite set of electrodes sufficiently above the bottom to prevent accumulation causing short-circuiting.

For the porous, non-conducting support, paper-board is used. After having been perforated, it is cut into grids of the required dimensions. To make the porosity still greater, these are treated with a solution of sodium caustic, which removes the sizing and other gummy matter, and leaves them much thicker. The edges of the grids are subsequently sealed with wax, or some similar substance, and the two faces or sides are varnished. A grid of very light weight and capable of absorbing a large amount of liquid is thus produced.

The perforations are conveniently filled with tablets or pellets of suitable materials. The spongy nature of the grid allows filling with the active materials in liquid or dry powder conditions, a suitable solution having been previously absorbed by the grid in the latter case, and then squeezed from it when ready. The conducting strips are cut from rolled sheet lead, which has been perforated and roughened on one side. The surface exposed in the electrolyte can be increased by grooving or corrugating. In some forms a connector is attached, but the strips may be left plain. The positive conductors are thicker than the negative ones, which are of light weight. Although in the drawings these strips are shown as completely surrounding or folded over the supporting plate, they need not be applied in this manner, but, instead, strips or conductors common to two plates may be interposed and secured in position when a number of plates are assembled for a section. By this arrangement the supporting plates may be removed from the electrolyte independently of the strips on conductors, or vice versa.

When a "lamellose" electrode is immersed in an electrolyte and charging has commenced, the absorption of the liquid, the accumulation of gases within the walls of the grid, and the expansion of the pellets of active material, tend to bend the strips and distort the plate. If the plate be used as a single positive or a negative electrode, this distortion, especially in the positives, is more disastrous. By using heavy ribbed conductors and bolting them through the plate at numerous points, bending can be prevented, but the dead weight of the cell is greatly increased, as is also the expense.

A lamellose electrode having thin lead strips when arranged in a section can be effectually prevented from buckling or bending, the expansion of the active material being a decided advantage in aiding stability.

In building a section, a number of these plates are arranged so that electrodes of the same polarity are opposed to each other. In order to allow good circulation of the electrolyte, the plates are kept a small distance apart by metallic separators, which are of cast lead or lead-alloy, being much cheaper than celluloid or hard rubber. They also serve to conduct the current between the plates, and to keep the strips firmly pressed against the pellets of active material. When the series of plates is bolted together, the strips, pellets, and separators are so firmly in contact with each other, that the terminal connections may be made at one plate only. It will be seen that there are no bolts or other fastenings extending through the plates, and that the strips are easily replaced.

The active material cannot be dislocated by jarring or shocks, and bending or buckling is impossible, the expansion of the positive active material only tending to force it more tightly against the strips and to compress the paper walls. The separators, *m*, are also constructed of other shapes and of insulating material, such as celluloid, when lightness is the desideratum. They may be even entirely dispensed with when certain shaped strips are used. As the capacity of a plate will depend upon the length and number of rows of perforations, there is a uniformity in the construction of plates of various sizes which lowers the cost.

I think that an accumulator thus made is likely to present the following advantages:—the support being of porous, absorbent material the diffusivity of the electrolyte is increased; being inoxidizable, it is unaffected by the electrolytic action; the conducting strips supporting nothing then are easily replaced; no asbestos, boards, or other devices are necessary between the plates, no matter how close; impossibility of short-circuiting from bending or buckling or dislocated material; ability to stand rough usage and jarring; no injury by high rates of charge or discharge; lightness, simplicity and cheapness.

THE ELECTROLYSIS OF MILK.[1]

In a paper by Mr. C. E. S. Phillips, the author, after referring to some of the tests adopted for ascertaining the purity of milk, proceeds to describe experiments undertaken to discover whether electrolysis would offer a more expeditious and reliable method than those in use. On electrolyzing a sample of milk between platinum electrodes, the anode became coated with a white, spongy-looking material which increased until so thick upon the plate that it ultimately became disengaged and floated to the surface of the milk; it was observed on making experiments in this way that the white deposit consisted principally of a mixture of caseine and fat, that the milk gave off a characteristic odor during the electrolysis, and it was found to be slightly alkaline after the operation. The liberated caseine floating upon the milk seemed to show that owing to alkalinity of the solution it had become insoluble; it was, however, evidently due to the lifting power of the gas bubbles clinging to it. By continuing the electrolysis further it was possible to extract practically all the solids from the milk used (80 cubic cm.), leaving a transparent solution behind; at the same time no appreciable deposit of any kind took place at the negative electrode. Tests made with litmus paper during electrolysis showed that the action was extremely local; it was, however, noticed that the froth on the negative electrode produced by a too rapid electrolysis was strongly alkaline. The formation of caseine on the positive electrode was then studied in a miniature cell under the microscope. On making the circuit bubbles of gas appeared upon each electrode, more of course at the negative one, but at the anode a yellowish deposit grew and spread uniformly out towards the opposite electrode. A dark ridge was built up about equidistant all along the electrode, and became more definite till the band widened out on either side, and concentrated at a point immediately opposite the cathode. Very peculiar movements could be made to take place in this band by making and breaking the circuit rapidly. Photographs showing these changes are given by the author. A drop of litmus used to stain the milk showed that an acid and an alkali were formed at the anode and cathode respectively, evidently accounting for the deposition of caseine at the former. The action would appear to be similar to that which takes place when milk is exposed to air for some days; lactic acid is formed, which throws down the

1. London *Electrician*.

caseine. By electrolysis, however, the action can be started and stopped as desired, so that any portion or all of the caseine can be removed from the milk. Next a small vessel was divided into three compartments by means of two porous partitions, and the effects recently described by M. Andréoli were tried. About 10 cubic cm. of milk were poured into the centre division, while the anode and cathode compartments contained a solution of sodium chloride. On the passage of the current a deposit was formed in the centre compartment on the side of the partition separating it from the anode. When all three compartments contained milk, the deposit occurred on the sides of both partitions furthest from the anode. Under these circumstances, it seems that an action takes place in the milk in the centre compartment. No deposit took place upon metallic plates immersed in the milk in either case. Some experiments upon the preservation of milk by means of this electrical withdrawal of a portion of its caseine were made, but with no success so far. Mr. Swinburne mentions, however, that milk can be sterilized electrolytically (*The Electrician*, Vol. XXIX., p. 891). In conclusion, the author states that platinum is the most suitable material to use for electrodes in the electrolysis of milk, as the lactic acid formed attacks most other metals. Aluminum can, however, be used in certain cases for the positive electrode, but it is eventually dissolved, and consequently of little use for quantitative work.

THE OPPORTUNITIES FOR ELECTRICITY IN CHINA AND JAPAN.[1]

BY WILLIAM E. CURTIS.

I have received several letters of inquiry concerning the market in Japan for electrical apparatus and supplies, and as to the prospect of Americans securing concessions for electric street railways and similar enterprises.

Answering the last question first, I would say that the policy of the Japanese government, as explained to me by the minister of agriculture and commerce, is decidedly against granting to foreigners concessions for any form of transportation or communication, or for any public improvements or conveniences whatsoever. He explained that the friction between the telephone, electric-light, gas, water-supply, railway, street-car and similar companies and their patrons was already becoming troublesome, and that parliament would very soon be compelled to enact laws similar to those in the United States for the regulation of such enterprises. It would be much easier to control and restrict them if they are owned by citizens of Japan. Foreigners would naturally appeal for protection to the diplomatic agents of their governments and perplexing complications might ensue. Therefore the ministry, which had given the subject long and serious consideration, had decided, and he believed wisely, not to allow the control of any public works to be placed in the hands of foreigners. There was no objection to the investment of foreign capital in their stocks and bonds, but the management must be strictly native, and laws would probably be passed requiring all directors of such corporations to be subjects of the empire.

Mr. Hunt, of Seattle, who is supposed to represent the Rockefellers, Gen. Alger, of Michigan, and other prominent capitalists, of the United States, has been negotiating for a concession to construct electric railways in Tokyo, but has received no encouragement. It is now proposed by his representatives to buy up the stock of the present horse railway and substitute electric trolleys or the cable system. In order to do this they will have to work through native agents and trustees, who must represent them in the management and the directory. The enterprise is a very tempting investment, as the present railway, which has a large equipment of very poor cars and charges only ½ a cent fare, is one of the most profitable business institutions in all Japan, and the present corporation has the privilege of extending its tracks indefinitely.

Mr. Hunt has also asked for two concessions in Shanghai, China, where he is working through the American Trading Company. One provides for constructing trolley or underground electric roads through the streets of the city, and the other for a trolley line between Shanghai and Wusung, a small town at the mouth of the Yang-'tze river, where a bar prohibits the entrance of heavy draught steamers. There is no doubt that both of these privileges would prove very profitable, but well-advised persons do not think that either will be granted. The British have a majority of the population, the property and the commerce of Shanghai, and naturally control municipal affairs in the foreign concessions. Their sentiment is against street railways. They are not accustomed to them in the old country and cannot be expected to favor their introduction elsewhere. Besides that, if any such privilege is granted they want it themselves and would scarcely permit it to go to an American.

The Chinese influence will be decidedly against the Wusung road unless the viceroy is admitted to a very large interest and is allowed to control it. A party of Englishmen built a steam railway to Wusung once, and operated it for several years, but the Chinese authorities bought the stock, tore up the rails and ties, and shipped them and all the rolling stock and other equipments down to Formosa, where it has since lain idle and has been very nearly consumed by rust.

The reasons for this peculiar performance were, first, that it interfered with the business of a large fleet of native junks and threw a great many men out of employment; but, what was more important, it affected unfavorably the Fung Shui, a mysterious geomantic influence by which the common people are largely governed in all the transactions of life. It is difficult for a foreign barbarian to comprehend the Fung Shui, but as near as it can be explained it represents the spirits of the dead, which are supposed to pass and repass through the air and exercise an irresistible influence on the affairs of mortals.

Numerous companies have been organized for the construction of electric railways in Japan, and many of them will doubtless carry out their plans in the immediate future. One proposes a trolley line in Yokohama, another an extensive system in Osaka, the most enterprising city in the empire and the second in population. Another contemplates the extension of the present trolley line in Kyoto, which is the only one in Japan. Similar enterprises are on foot in Nagoya, Kobe, Nagasaki and other places, and it is certain that within the next few years all the cities will be amply provided with street railway facilities, although there are now but two lines in the whole empire—those in Tokyo and Kyoto, to which I have referred.

There are also applications pending before the government for electric lines between Yokohama and Tokyo, a distance of eighteen miles, and between Kobe, Osaka and Kyoto, forty-eight miles, where the territory is very thickly settled; but both of them propose to parallel steam railways owned by the government, and it is a question whether they will be permitted, for financial reasons. The present roads pay dividends of 9 per cent. and more into the public treasury, and their earnings would be reduced by competition.

Although Americans and other foreigners may not actively engage in the management of these enterprises they offer a very tempting opportunity for the investment of capital, and will afford a large market for steel rails of light weight and electrical material when their construction is commenced

The Japanese are very well advanced in the science of electricity. A large number of native engineers and electricians have studied in Europe and the United States, and there are manufactories of electrical supplies in most of the larger cities, which turn out much of the ordinary material now demanded, although they have not yet attempted to produce motors. Some of the finest electric plants in the world are found in Japan. They are used for coal mining, cotton-spinning, lighting and for general manufacturing power, and at Kyoto boats are carried up and down the rapids of a river just outside the city by apparatus that is said to be as complete and ingenious as any in existence. It was planned and constructed by a young native engineer, but the machinery was purchased in Germany. The same plant lights the city, runs a street railway and several small factories. It now furnishes 28,000 horse-power, which may be increased indefinitely, as the water-power comes through a canal, also used for irrigation and navigation, from Lake Biwa, which is forty-seven miles long, an average of nine miles wide, an average of ninety feet deep, and receives the drainage from a large range of mountains.

Telephone, lighting and ordinary mechanical apparatus and supplies are produced in Japan. They are mostly imitations of European and American patents. The materials and some of the parts for motors and other machinery are imported from Germany and Belgium, but they are put together and the simpler parts are supplied here. It will always be necessary to import materials, as they do not exist in Japan, and foreign appliances are so much superior to the local products that wiser people prefer them even at a much higher cost, and will continue to do so until the Japanese have reached a similar state of perfection.

There are several large houses dealing in foreign electrical supplies, and one finds contributions from the Brush, Edison, Thomson-Houston, Westinghouse and other American manufactories; but the Germans and Belgians have pushed the trade with greater energy than our people, and consequently have sold more goods. They have established agencies under competent engineers, who learn the Japanese language and mingle among probable purchasers, to make their acquaintance and talk business. The Europeans do not appear to be afraid of the infringement of their patents, although many of them are imitated as fast as they are introduced into the country.

American manufacturers must take the same measures if they wish to increase their sales. They can do very little by correspondence or by sending catalogues. They must go to Japan themselves, get acquainted with the people, study the peculiar requirements of the market and the methods of doing business, and conform to them as closely as possible. Long credits are not expected as a usual thing, but the purchaser will usually insist upon paying on delivery through the Japanese banks.

I cannot discover that European merchants ever lose money by accepting contracts or filling orders if they comply strictly with their provisions, but the Japanese are a suspicious people. They have been taught by an expensive experience to distrust foreigners.

1. The *Chicago Record*.

When the country was first opened to trade they were humbugged and swindled right and left, particularly by Englishmen, and I regret to say, by some Americans. This not only made them cautious in their dealings, but they learned a great many tricks which they often practice now upon their former instructors. When they have once learned that they can place confidence in a man they trust him implicitly, but when there is a contest of wit the Japanese is a hard man to beat. As a trader he will rank with the Jews, Greeks and Armenians. A dishonest Japanese is utterly unscrupulous and audacious to an amazing degree. But among the people generally you find as high an average of honorable men as in any European country or the United States, and when they recognize honorable dealing they return it in kind.

The government is a very large buyer of telegraph, railway and electric supplies. It patronizes home industries wherever practicable, but the policy is to get the best possible material for the money, and the officials recognize the inferiority of the Japanese products. Some of the electric light plants are owned by municipal corporations, and they buy a great deal abroad. The railway iron used both by the government and private corporations for steam and street railways is much lighter than we are accustomed to in the United States. Most of it comes from Belgium and England, but it might be shipped by sail from the Atlantic coast ports of the United States and placed in Japan at prices quite as cheap as those charged for European goods.

THE RATING AND BEHAVIOR OF FUSE WIRES.[1]—I.

W. M. STINE, H. E. GAYTES, AND C. E. FREEMAN.

The thermal cut-out is still one of the most unreliable of the many devices employed on electric circuits. Its use is universal, but beyond a few practical details the device is but little understood. The blocks in which they are used show some slow improvement, but most of this has been due to the vigilance of insurance boards, and they are still far from perfect. As a source of vexation and uncertainty, the fuse is probably unrivaled.

All tests and treatments have shown the thermal cut-out to be subject to such variations and modifying influences that but little of practical value can be deduced from analytical investigations.

These considerations led the writers to attempt further investigations. The fuse was dealt with as an auxiliary to electrical circuits, and its behavior under such conditions was carefully studied. Naturally, the data obtained has been voluminous; in all some 1800 determinations; but great care has been taken to thoroughly check all results.

The Apparatus.—Fig. 1 is a plan drawing of the main and auxiliary apparatus, with all connections indicated. One of the dynamo leads was brought to the switch S. This switch was especially designed and constructed for these tests. The pivot was placed well toward the handle to make the travel of the blade as rapid as possible. The carbon rheostat, C. R., was built up of carbon plates, whose contact resistance was readily varied by screw pressure. The fuse was tested in a large box lined with asbestos, and open at the top, permitting of inspection and access, while at the same time protecting the fuse from draughts. The lamp rack, P, held 100 16-C. P. 110-volt incandescent lamps. These were connected in groups to switches, which enabled any combination from 1 to 100 to be used. A step-by-step rheostat in multiple with this rack was used to adjust the current through the interval of one lamp.[2] By its use the current could be accurately adjusted within the limits of .4 and 60 amperes. For higher currents several similar racks were placed in multiple: L_1 and L_2 were small "pony" relays of 20 ohms resistance, having in series with each five 16 C. P. 110-volt lamps (R_1 and R_2). These relays worked on a current of about 10 milliamperes each, and were wired to close the circuit through the primary of the induction coil I. Two storage cells furnished the current for these relay circuits. T was an electro-magnetic tuning-fork driven by an independent storage-cell; C an iron chronograph drum which was turned by hand. The secondary or spark circuit of the induction coil was connected to the tuning-fork and the chronograph drum respectively.

Method of Experiment.—The current to which the fuse was subjected during the test was first measured accurately by throwing the switch on contact O, and passing it through the Weston ammeter, A. Both the circuits passing from the jaws O and N of the switch to the point of conjunction Q, were short, and of No. 4 A. W. G. wire. It was thought best to take the resistance of the fuse into account, and adjust the resistance of the ammeter circuit to exactly equal that of the fuse circuit. To accomplish this a current smaller than the known fusing current was sent through the fuse, and the fall of potential from S to Q noted on a Weston milli-voltmeter. The current was next switched on the ammeter circuit and the fall over this from S to Q, was made exactly that over the fuse circuit, by adjusting the compensating carbon rheostat. The fusing current being accurately measured was switched on over the fuse. The fusing time was thus accurately ascertained. The lamp rack being a non-inductive resistance, the time interval for the current to rise to its full value on the fuse is negligible for all but the very shortest periods. The resistance of the bank of incandescent lamps could not materially alter during the quick throw of the switch, which was thrown by striking it a blow on the handle. Frequent observations made on the lamps did not reveal even the slightest tremor of the light when the switch was thrown. To render the point more certain, the time interval between the break and make of the switch was accurately determined chronographically, and found to vary between $\frac{1}{700}$ and $\frac{1}{1500}$ of a second. The fusing times were noted on a stop watch for all periods exceeding one second. For shorter periods the chronograph arrangement was used. The tracings of the electromagnetically driven tuning-fork T, were made on smoked paper fastened over the drum C. This fork was always rated before each set of experiments by switching it in circuit with a standard-second clock. Its rate was about 67 double vibrations per second. By frequent timing, all changes in rate due to temperature, etc., were noted and allowed for. The amplitude of the fork was large enough to allow periods of less than $\frac{1}{1500}$ second to be accurately measured. The records on the drum were made by sparks from the induction coil upon the breaking of one of the relay circuits.

The action of the relays was as follows:—When the switch was on O, L_1, was closed and L_2 open; when the contact was broken at O, L_1, opened, throwing a spark on the drum, and L_2 closed. The switch making contact at N, L_1 closed and L_2 opened, making the second spark record. When the fuse blew, L_1 opened, causing the third spark record. Though both relays acted synchronously,

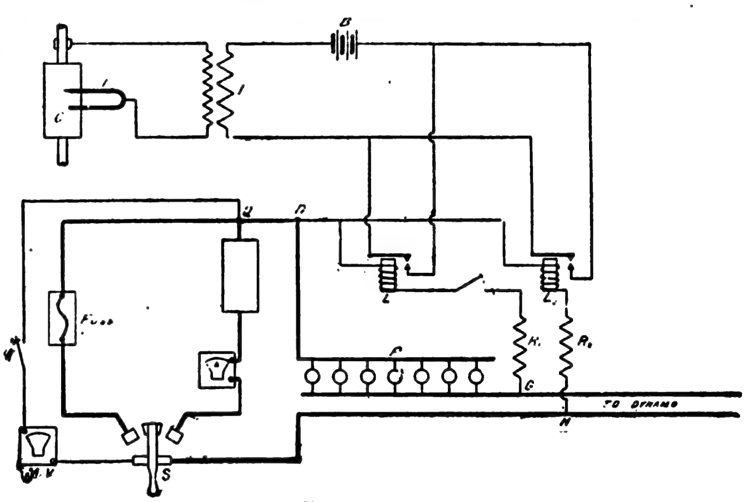


FIG. 1.

there was an interval during which the current through coil I was completely broken. Two distinct records were made in every case. The interval between the first and second sparks gave the period of open circuit for the switch, while the interval for the second and third sparks gave the fusing times. The relay circuits are indicated with sufficient clearness on the diagram.

The Experiments.—As our experiments were designed to exhibit the behavior and characteristics of the fuse used for protecting electrical circuits, it was considered best to adopt not more than two brands of wire for all the tests, rather than employ a large number of varieties. Other investigations have shown that the various makes of fuse wire closely resemble each other in behavior, and the conclusions obtained with one wire would be general for all. The first make of wire was purchased from supply houses, the second was furnished by the manufacturers.

First Series.—These tests were made under conditions which we shall call commercial, or those which obtain in practice. In all cases the fuse wire was carefully inserted, so as to obtain a uniform pressure of the wire under the screw head without unduly crushing it. The same block was used repeatedly, and little care taken to keep the terminals clean. This was done to more nearly imitate practical conditions. In only two or three cases out of hundreds of fuses blown did the rupture occur at the contact. Two classes of porcelain cut-outs were employed; one was the open porcelain base "Main Line" style, the other the closed porcelain "E. W." variety. In the latter, the 10-ampere size has a space of only ½ inch between its terminals, though the fuse is suspended out of contact with the porcelain base. This style of block has recently been condemned by the underwriters, and very properly. With the terminals so close together, a fuse blowing under 20 amperes invariably establishes a vicious arc, and the terminals melt with such explosive violence as to frequently shatter the block. Though the open type of block has an added fire risk, the terminals are, as a rule, further apart. A pronounced

1. Read before the Am. Inst. Elec. Engrs., Oct. 23, 1895.
2. For illustrated description of this lamp-rack see *Electrical Review*, New York, October 24, 1894, p. 201.

fault in their construction is that the terminals are set in flush with the surface of the porcelain. Nearly all types of porcelain fuse-blocks merit severe criticism on several points. The terminals are too close together in small sizes, the fuse often resting on the top or base; and their mechanical construction is very poor. Too little attention seems to be given to the proper function of a fuse-block in its design.

Table I needs but little comment. It clearly shows the unreliability of the porcelain fuse-blocks used, and also the imperfect commercial rating of the fuse wire, A. The limit of fusing time was 60 seconds. Fuses larger than five amperes will often blow in from one to three minutes on a current somewhat less than stated, but this correction is so slight for these results that it need not be seriously considered.

TABLE I.

FUSING CURRENTS IN AMPERES.—LIMITING TIME 1 MINUTE.

	A ½ Amp.	A 1 Amp.	A 2 Amp.	A 3 Amp.	A 5 Amp.	A 10 Amp.	A 15 Amp.	B 4 Amp.	B 8 Amp.	B 12 Amp.
Covered Block, ½ inch...	2.5	5	10	14	20	35	—	13'	—	—
Open Block, ½ inch......	3	5	9	10	15	25	—	—	—	—
Open Block, 1 7-16 inches.	—	—	—	—	—	—	30	—	—	—
Open Block, 8 inches Vert.	1.5	3	5	6	9	14	20	—	7.5	20
Open Block, 8 inches Hor.	2	4	6	7	11	—	20	—	—	—

TABLE II.

FUSING TIMES IN SECONDS.

Amp.	I.	II.	III.	IV.	V.
15	84	75.8	—	—	—
20	36.6	35	—	—	—
25	19	17	60	45	195
30	12.8	10.8	33	26	41.6
35	9	7.6	20	16.4	30
40	7	5.8	14	12.6	25
45	5	4.8	10.4	9	17
50	4	4	9	7.4	13
55	3.6	3	6.6	5.8	—
60	3	2.6	5	5	8
65	2.8	2.2	4	4.6	—
70	2.8	1.8	3.6	3.6	5.4
75	2	1.6	3	3	—
80	1.8	—	—	2.6	4.8
85	—	—	—	2.2	—
90	—	—	—	2	3.6
95	—	—	—	1.8	—
100	—	—	—	1.6	3.2
105	—	—	—	1.4	—
110	—	—	—	1.2	2.8

I.—20 Amp. B. Horizontal 8 inches Mica supports each inch.
II.—20 Amp. B. Vertical 8 inches.
III.—20 Amp. A. Horizontal 8 inches Asbestos supports each inch.
IV.—20 Amp, A. Vertical 8 inches.
V.—25 Amp. A. Vertical 8 inches.

Second Series.—The open eight inch block was adopted to avoid all cooling effects from the terminals. When used horizontally, the fuse rested on a number of thin asbestos supports set into groves one inch apart, the fuse being elevated one inch above the base of block. In those tests in which the block was placed vertically, hydrostatic pressure lowered the fusing point, but when used horizontally the data may be regarded as the normal fusing points for these various wires.

The data of Table II will be clearly understood from the accompanying legends. One of our objects was to accurately measure the fusing times for abnormal currents. It is characteristic of all electro-thermal devices that they are sluggish in action. Cases may arise in practice where the insulation of wires is forced to become a fuse competing with the metal supposed to protect the circuit. In all such cases it is only a question as to which shall yield the sooner. There is sufficient evidence in this table to explain why a fuse does not always protect an armature from burning out. The table becomes the more significant in this light when it is noticed that the data has been obtained by the use of an abnormally long fuse-block. With the commercial block the fusing times were increased many fold.

"TRUE TO ITS MISSION."

THE ELECTRICAL ENGINEER tells us on its title page, that it is "A weekly review of theoretical and applied electricity." That it is true to its mission, a glance at its contents will plainly demonstrate.

Scarcely an event, surely none of any marked importance, has occurred in the electrical world that is not set forth in detail in the columns of this journal. During the past month it has contained many interesting and instructive articles.—*Pacific Wave, Seattle.*

ELECTRIC LIGHTING.

READING, MASS., MUNICIPAL LIGHT AND POWER PLANT.

Reading, Mass., is proud of its municipal light and power plant, which has just been completed, at a cost of $62,000, and is now in operation. The power house is 79 x 45 feet, has 6 ft. foundations of heavy stone work, with granite underpinning; 22 ft. high brick walls; and iron trussed, planked and slated roof, sheathed on the under side with cypress. The basement is 7 ft. 8 in.; it has iron girders, bricked arched and cement concrete on top. On the cement is laid a terrazo floor similar to that in the new city hospital in Boston, which gives a smooth marble surface. The height from the power room floor to the top of the brick wall is 18 ft., and to the apex of the roof 40 ft. There is no wood finish in any part of the building, except in doors, window frames and partitions for offices. All the stairways are built of iron. The foundations for shafting and all machinery are built from the ground, running up through the floor and surmounted by granite blocks.

Attached to the power house is the boiler house, which measures 41 x 44 ft., with 15 ft. high walls. The height, from floor to apex of roof is 28 ft. The roof is pitched, iron trussed, planked, slated, and wire plastered on the under side. The ventilator is dome-shaped, and copper covered, and all the trimmings throughout the building are of copper. The brick chimney is circular in form, 115 ft. high; 12 ft. diameter at bottom, and 8 ft. at the top; iron capped, and having a 15 ft. flue. The architect is George E. Abbott, of Reading, and 53 Tremont street, Boston. The contractors are Edward E. Strout,—buildings and chimney, all brick and stone work, all iron work except roof, and all carpenter's work except sheathing; the Boston Bridge Works, iron trussed roof; Frank G. Coburn & Co., foundations for buildings; Dimmock & Milbury, sheathing roof; Boston Mosaic Co., terrazo floor.

The machinery includes one girder frame Reynolds-Corliss engine, 20 in. cylinder, 42 in. stroke, of 200 rated H. P.; and one 14 in. cylinder, 36 in. stroke, of 100 rated H. P. The fly wheels, built also by Edward P. Allis & Co., of Milwaukee, Wis., are respectively of 15 and 10 ft. diameter, and weigh 21,500 and 11,000 lbs. There are two horizontal tubular boilers, built by Edward Kendall & Sons, of Cambridgeport, Mass. The diameter of the shell is 6 ft. Each boiler contains 140 tubes, 3 in. diameter, and 16 ft. long, and is rated at 125 H. P. The belting is furnished by Chas. C. Ireson, of Boston, and the shafting, with all necessary floor slants, pulleys and clutches, by James Hunter Machine Co., of North Adams, Mass.

The generating plant consists of three Westinghouse arc dynamos of 50-1200 C. P. lights each; one 75 K. W. two-phase alternator, of 1500 16-C. P. capacity of which 100 H. P. is devoted to motors during the day. The lamps are Western Electric. The pole line is 22 miles in length. The station is wired for 5 arc lamps and 85 incandescents. The contract for all the electrical work, except wiring for the commercial line, was awarded to the Westinghouse Electric & Mfg. Co., Pittsburgh, Pa., who sublet the building of the pole line and wiring of the station to the Hawks Construction Co., of Boston; the steam fitting and Worthington pump going to Wm. H. Gallison, of Boston. There are 45 miles of arc lines, and 25 of incandescent. The mechanical engineer is F. O. Wellington, of Braintree; electrical engineer,

THE READING, MASS., ELECTRIC LIGHT STATION.

J. Frank Perry, of Braintree; and electrical superintendent, E. T. Jordling, of Reading. When fully regulated, the running time of the station will be: street lights, from dark to 1 o'clock A. M., and during short winter days from 5 o'clock A. M. till daylight: incandescent or house lights, from dark until daylight.

THE NEW MUNICIPAL ELECTRIC LIGHTING PLANT AT INDEPENDENCE, IA.

Operations are being briskly pushed on in the installation of the new municipal electric lighting plant at Independence, Ia. The contract for the engines was given to the Sioux City Engine

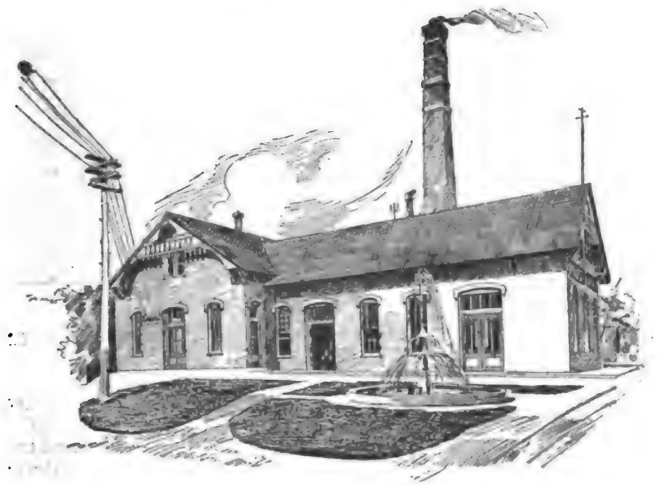


FIG. 1.—INDEPENDENCE, IA., MUNICIPAL PLANT.

Co., that for the dynamo and line construction to the Standard Electric Co. of Chicago, and that for the boiler to the Link-Belt Co., of Chicago. It is expected that the plant will soon be in full operation. The Sioux City Corliss engine runs at 100 revolutions per minute, 125 pounds boiler pressure at one-fifth cut-off, and will develop 325 H. P., on the guaranteed consumption of 16 pounds of steam per horse power per hour. The boiler is guaranteed on a working pressure of 165 pounds to the square inch, and will evaporate eight pounds of water on the consumption of one pound of coal per hour. The engine is of the cross-compound type.

Instead of the usual leather belt between engine driving

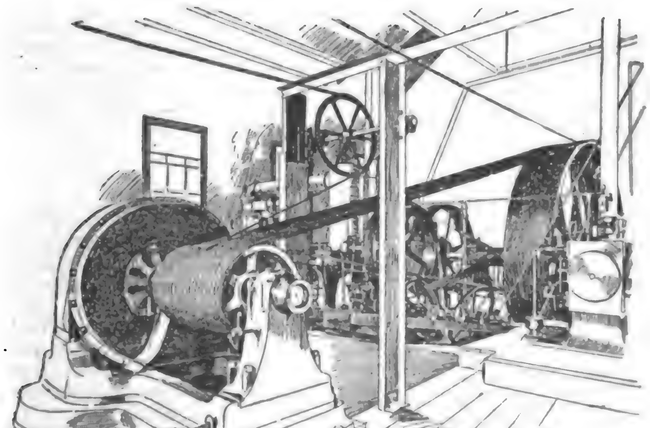


FIG. 2.—INTERIOR OF INDEPENDENCE, IA., STATION.

pulley and dynamo this plant has a rope drive, furnished by the Link-Belt Co.

The incandescent dynamo was furnished by the Standard Electric Co., of Chicago. It is self-regulating, of 180 K. W. capacity, and large enough to furnish 2,500 lights at all times. It has no commutator and no brushes. It is their latest and most improved alternator. The armature is stationary and the field revolves. The exciter as well as the alternator is of the multipolar type. The switchboard in the house is of white polished marble. All the switchboard instruments are enclosed in plate-glass cases, dust-proof, and are of the latest and most approved pattern.

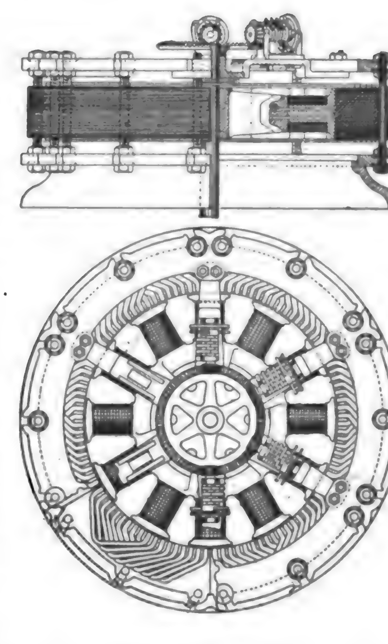
The poles in the line work are 30 and 40 feet long, 6 inches at top, and are painted black to 8 feet from ground, and white above that. They present a very fine appearance. A street lamp of 32 C. P. is located at each street intersection, and more frequently where needed. The contract provides for 225 street lamps in all. The commercial lines run to the most important portions of the city, and will be extended as occasion demands. The contractors furnish 1,000-light capacity of transformers for the commercial line.

A poor little plant, such as most towns are afflicted with, might have been put in for considerably less money. But the council have proceeded on the theory that it is better to build large enough for any probable future, and well enough to obviate as far as possible the annoyance and expense of repairs for slighted work. A plant has been provided, of which all citizens may well be proud to be part owners. It is as good as money can buy. It belongs to the people, and hereafter the responsibility for its operation depends on them.

The water-works occupies what is now the "L" part of the city plant building, and the boilers are also located in this part. The new or main part is occupied by the electrical machinery, with a large coal room at the rear and a supply room over the coal room. The electrical room is supplied with a gallery for the accommodation of visitors. The boiler plant now consists of the new water-tube boiler of 300-horse capacity and two tubular boilers put in for the water plant in 1886. These boilers are so connected as to be interchangeable. Any or all of them may be used at any time for either plant or for both plants. By the combination of both plants under one roof, economy of help, fuel and other operating expenses will be effected.

THE THOMSON MULTIPLE CIRCUIT ARC LIGHT DYNAMO.

Prof. Elihu Thomson has recently devised an interesting form of multipolar dynamo directly connected for a series of arc light circuits, and in which the commutation and regulation of each of the separate circuits is as simple as in the ordinary types of arc lighting machines. A series of arc lights may be run with continuous current on each circuit if desired.



The machine is shown in plan and sectional elevation in the accompanying illustration. It consists of a revolving set of multipolar field-magnets on a water-wheel or steam-engine shaft, the number of poles being chosen with respect to the speed and rate of cutting of the lines desired. The armature is stationary and is provided with circuits non-overlapping, constituting groups of three coils or three-phase windings, from which three terminals are carried out. This winding is supported on a laminated structure, divided into sections, so that any section may be removed with its winding for repairs without disturbing the integrity of the rest of the structure, which may even be run with one or more sections removed.

In order to commute the currents, commutators are driven synchronously with the machine or at higher rates by direct gearing as shown. The machine-shaft carries a large gear which engages with small pinions on each of the commutator-shafts, the commutators being revolved at a speed relatively greater than that of the main machine in the proportion of half the number of poles in the main machine—that is, the commutator is virtually bipolar, or if the commutator has four poles its speed would be one-half as great. If the field-poles of the main machine are twelve in number, as shown in the figure, the commutator would revolve six times as fast (if bipolar) as the machine. Each of the commutators carries three rings for connection by brushes to the stationary armature-windings, and carries, also, a three-segment commutator with the ordinary arrangements of brushes, either controlled or not by a regulator.

The currents of the machine may be made by the armature reaction, resistances, etc., to be of the nature of those supplied by arc-lighting machines, tending to a fall of potential on an increase of current, and thereby giving stability to the current on the circuit; or particular devices—such as reactive coils, constant-

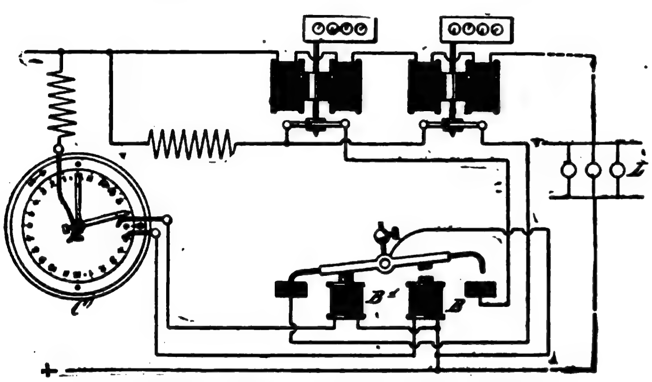
current transformers, etc.—may be inserted between the connections from the stationary windings and the commutating devices, and a transformation of potential up or down may be at the same time accomplished if transformers are employed. While the machine is thus primarily adapted to work a number of circuits of arc lights, it may be on occasion employed to operate three phase motors or three-phase lighting circuits, or may be used in various transformer combinations to operate two-phase or other polyphase systems.

THE BARSTOW DIFFERENTIAL METER FOR LIGHT AND HEAVY LOAD.

In the operation of central stations there frequently occur periods when there is a small demand for the current, at which time the larger part of the machinery of the station is idle and does not earn its proportion of the fixed charges. In order to "even up" the demand for current so that as much as possible of the machinery necessary to carry the maximum load can be utilized during the minimum, the consumer should be induced to use more current during these minimum periods. The most natural form of inducement is a reduction in the price of current at such times, so that the net price shall be cheaper than gas. This "inducement period" should be during the small load of the station, and, of course, varies with the seasons of the year.

To facilitate the adoption of such a system, Mr. William S. Barstow, the manager and engineer of the Brooklyn Edison Company, has devised a meter which affords protection to the electric company by preventing the consumer from using the low price current during hours of maximum load.

The accompanying illustration shows the device where a



Barstow's Differential Current Meter.

mechanical meter is used. It can, however, be applied equally well to an electrolytic meter. It consists essentially of two meters giving independent readings, and a clock work for measuring time and for throwing either meter into action at a predetermined moment. The operation will be clearly understood by reference to the illustration. The solenoids B B' are energized alternately by the clock, or time switch, C, and the current that goes to the lamps, or other translating devices, L, is thus measured by either of the meters according to the time of day.

Mr. Barstow also suggests the use of two meter trains with but one driving motor placed between them, the shaft of the motor driving the two trains alternately.

A PARK PLANT FOR CHICAGO.

Mr. Foree Bain has been selected as engineer to design, purchase and install an electric light plant, for the purpose of illuminating the parks and boulevards, in the City of Chicago for the West Side Board of Park Commissioners. The plant will consist of 1,000 horse power boiler capacity, two 500 horse power compound condensing Corliss engines, a six inch jack shaft, with automatic oilers, necessary clutches and pulleys, and eleven 100 light arc dynamos. There will be one thousand 2,000 candle power arc lamps installed. The lamps will hang from newly designed park poles. The wire will all be placed underground. There will be required for the plant about 100 miles of underground lead covered cable No. 5. When finished the plant will be a model. It is Mr. Bain's design to construct the plant with a view to the lowest possible cost of operation. The work of placing the conduits will be begun at once. Apparatus will probably not be required before the first of the year. Mr. Bain is now drawing specifications with a view to submitting them for the purpose of receiving propositions for the apparatus required.

Boston, up to Oct. 22, had opened 60,800 feet of trench for underground work, laid 275,000 feet of duct and drawn in 505,500 feet of cable.

THE HUTCHINS SAFETY APPLIANCE FOR DANGEROUS CURRENTS.

BY A. B. HUTCHINS.

I hand you a photograph showing a test made at the electric light station of this city (Detroit) recently, with my automatic safety receiver for fallen dangerous electric wires, in which test I am protected through a metallic ground water pipe, against the open or broken section of line wire and also through an additional ground wire run from the other side of the dynamo and grounded (its bare ends) in the moist earth 250 feet distant, toward which point I was able to approach very closely with an

The Hutchins Method of "Deadening" Dangerous Broken Wires.

extension of the broken line wire. Then I was not able to detect any current conducting through myself by the path afforded by broken wire, though I held the end of the wire in my mouth and trod the wet ground barefooted. If this subject is a matter of interest to your readers you are at liberty to use it, and I will give you account of other tests if desired.

Take, for instance, a line of wire for electric lights, overhead in our streets. I simply put a small wire on a pole similar in purpose to a lightning rod for a house; the top of this wire I split into a fork, or fasten to a specially made insulated metallic bracket; the bottom of the wire is run into the ground where it may be connected to a special ground wire or a water or gas pipe. This bracket or crotch only touches a bare spot on the suspended dangerous wire when it falls; then it operates to carry the deadly current right down the pole wire to the ground. Electrically speaking, it provides for the electric current a low resistance shunt, and places the fallen wire at one, or earth potential, or similar to the ground current of an electric railroad.

MORE ELECTRIC LIGHT FOR BROOKLYN.

The State Electric Light and Power Company of Brooklyn, has been granted a franchise to operate and maintain a plant and to lay electric wires on condition that the company pay to the city each year $500, and 1 per cent. of its gross receipts, and that it would not charge the city more than 30 cents a night a lamp, nor citizens of Brooklyn more than 35 cents a night a lamp.

THE ENCLOSED CARBON LAMP CO.

The Enclosed Carbon Lamp Co. is a new organization, principally of Ironton, O., capitalists. The purpose of the company is to manufacture and sell appliances for arc lights wherein the carbon is inclosed in a nearly air-tight glass tube, which causes the carbons, which in ordinary lights burn but eight hours, to burn from sixty to seventy hours. The lamp is the invention of G. G. Stout, of Parkersburg, W. Va., who patented it in August, 1894. The company will permanently organize with J. R. Cook, president; G. G. Stout, vice-president; E. W. Bixby, secretary and treasurer. The capital stock, all subscribed, is $50,000.

The appliances, which are attachable to any arc light, will be manufactured in Pittsburgh, but the company's place of business will be Ironton.

"JUST THE THING FOR PRACTICAL MEN."

Mr. H. W. Jeannin, Supt. of the Jonesboro, Ark., Power Co., writes:—"You will find enclosed 60 cents for which please send me by return mail one of your morocco Filing Cases. I cannot express my appreciation in words for your enterprise in getting up those Data Sheets. It seems just the thing for practical men (such as myself), who are struggling under small salary to get a foothold in the field of electricity, who start in without a technical education and learn what they can by dint of hard study and the expenditure of about all their means. I have found it very hard work and expensive to collect such data as pertains to my business in all of its details, viz.: Electric Lighting. The Electrical Engineer is my favorite, and I will always speak a word of praise for it whenever the opportunity offers."

LETTERS TO THE EDITOR.

MANY LAMPS TO ONE SOCKET.

It is with much interest that I have noted your recent editorial and the comments in reference to standardizing lamp sockets. I trust that you will continue to keep this matter before the manufacturers and central stations until the next convention of the National Electric Light Association, when it is to be hoped that some action will be taken. As the T.-H. base costs more, it should not be considered. The fact that the T.-H. socket is cheaper does not make up the difference, as a good many lamps will be burned out in one socket. There is but little choice between the Westinghouse, and Edison base, and I am not informed as to the exact present status of the litigation of the Edison socket patent.

It is now the practice of the lamp manufacturers to carry a large part of their finished lamps without sockets, and it would simplify matters greatly if they could carry their stock finished and packed in standard packages; and the dealer would be in better position to fill orders with one-half the stock that he is now obliged to carry.

F. S. TERRY, V. P.
THE SUNBEAM INC. LAMP CO.

CHICAGO, ILL.

THE STORY OF AN IMBECILE MOMENT.

The question of standardizing a lamp socket if left to practical engineers and supply men would be, I feel sure, decided in the affirmative without a dissenting voice.

The general tone of the several published letters on the subject which I have seen, favors the choice of either the Westinghouse or Edison socket. My choice, and that of nearly all contractors I have come up with, is for the poor old T.-H. which "costs $7 to $8 per thousand more." "How often, oh! how often" have we had our telephone whisper to us that "quite a number of our lamps are not burning, send your expert immediately," but we are wise and we detail the office boy for the job, whose experienced hand twists the Edison lamp a little tighter, and pushes the Westinghouse lamp a little further. Perchance the latter is rebellious and it is necessary to tighten the springs by squeezing before the glow appears.

I wired a large synagogue in the East some time ago and in a moment of imbecility decided to use Westinghouse sockets. Two hundred lamps protruded straight down from the ceiling and one would think that it was intended that they should fall, so readily and regularly did the lamps do so.

Let us have a standard socket by all means but in the considering of the same let the T.-H. enter. If the cost is really so high as to prohibit its use as a standard let us put off the question until some inventively inclined mind gives us a socket worthy of being called a "Standard."

Mr. Rhotehamel in his letter writes that the adoption of a standard socket would do away with the carrying in stock of lamps of so many different *voltages* and *candle-power*. A help and convenience it would be, but I fail to see how either of the underlined qualities could be affected.

PAUL N. D'UNGER.

CHICAGO, Oct. 28, 1895.

CAN YOU TELEGRAPH THROUGH THE HOOSAC TUNNEL?

IN your issue of the 30th inst. I noticed an inquiry relative to the Hoosac Tunnel. Some time ago I saw in the *Scientific American*—page 179, issue of Sep. 21st—the following note, which I copied at the time intending to call your attention to it.

"The Boston Journal of Commerce says that North Adams continues to be puzzled over a queer crankism of electricity in its vicinity. Although when the great four and a half miles Hoosac Tunnel was built, no ores, magnetic or otherwise, were encountered, there was general expectation that rich ore pockets would be found; yet for an unexplained reason, not an electrician has been discovered who can send a telegraphic message on a wire running from portal to portal of the tunnel, be such wire run inside of an ocean cable through the huge cavern or out of it. Therefore such messages have been sent on wires strung on poles over the top of the mountain, fully nine miles, and that is the way ingoing and outgoing passenger and freight trains are heralded to the keepers of the tunnel approaches."

Considering the original authority for the paragraph, I did not place much faith in its accuracy, and thinking you would feel the same way about it, I let it slip.

Evidently the above is the statement written of by your Troy correspondent.

JAS. W. MANSON.

NEW YORK CITY, Oct. 31, 1895.

"I think the Data Sheets is a great idea and it will be appreciated I know." P. Canfield Barney, Brunswick, Mo.

POWER TRANSMISSION.

THE CARBORUNDUM ENTERPRISE AT NIAGARA FALLS.

On October 30th, a meeting of the directors of the Carborundum Company was held at Niagara Falls, at which they decided to commence at once the erection of a new factory there for the manufacture of carborundum wheels, hones and other articles. This factory will be operated in connection with their new plant, and it will contain two large new kilns that will have an interior diameter of 16 feet, and which will give them at least six times the capacity of the kilns now in use in Monongahela City, Pa. One of the results of this early addition to the Niagara carborundum plant will be the entire abandonment of the Monongahela City plant and the removal to Niagara Falls of the skilled employés and their families, while in addition the company will also largely increase its force. This will be necessary, owing to the fact that the capacity of the carborundum furnaces at the Falls is 2,000 pounds a day, as compared with 300 pounds which is the capacity of the Monongahela furnaces.

That the Carborundum Company should thus early decide to enlarge their Niagara plant is full evidence that they thoroughly appreciate the cheap Niagara power furnished by the Cataract Construction Company.

FURTHER POWER UTILIZATION AT DAVENPORT, IA.

ARRANGEMENTS have been made between the United States government and the People's Power Company for the erection of an immense wing dam just above the government island at Davenport, Ia. Thirty turbine wheels will be put in. Two 1,000 horse-power dynamos will be put in by the company in addition to those already in operation. The improvement will cost about $150,000, and will revolutionize the manufacturing industries of Davenport, Rock Island and Moline.

THE FRESNO TRANSMISSION.

The Fresno, Cal., local papers mention the recording of the agreement between the San Joaquin Electric Co. and the General Electric Co. for the power transmission from San Joaquin to Fresno. One item is for 2,112,000 feet of copper wire. There are to be 1,000 incandescent lamps and 160 arcs. The item of cost in the contract is said to be $112,500.

ELECTRIC ORGANS ON THE "ST. LOUIS."

One of the latest triumphs of organ building was the placing of pipe organs in the two new steamships, St. Louis and St. Paul. The work was performed by George Jardine & Son of this city, and although serious problems were presented by the pitching of the vessels, the unusual amount of moisture in the air, and the form of the vessels, all have been solved successfully. The organ stands in the grand salon. The pipes are placed near the ceiling and the keyboard is about thirty feet away. This organ contains one device which has been found exceedingly convenient. This is a switch, by means of which the electric current may be turned off and the organ silenced at any time. The English steward of the St. Louis explained the advantages of this arrangement

"You cawn't insult passengers by telling them they don't know how to play, don't you know," said he, "so when any confounded Johnny gets aboard the organ I just turn this little switch, and he cawn't tell what has struck the biawsted machine."

OBITUARY.

HOLBROOK CUSHMAN.

Holbrook Cushman, the head instructor in the department of physics in Columbia College, died from heart disease on Oct. 24, in this city. Mr. Cushman was 38 years old. He graduated from Columbia in the class of 1878. He was appointed fellow in science, and continued his studies at Würzburg, Germany. On his return to this country he engaged in the electric business, with the Western Electric Co., until 1890, when he accepted the post in Columbia College that he held at the time of his death.

GEORGE F. CURTISS.

News has reached us of the death of Mr. G. F. Curtiss, of Boston, a graduate of the Massachusetts Institute of Technology, and for some years actively connected with the Thomson-Houston and General Electric companies, chiefly at Lynn. He was an engineer of considerable ability and energy, and his death while so young is a painful surprise.

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CONTENTS.

SUPPLEMENT.

ELECTRIC POWER AND CENTRAL STATIONS.

THE belated statistics of 1890, furnished by the U. S. Census, relative to the electrical industries of the State and City of New York, have not much value, but they serve at least to show how rapidly some branches of the art are now developing. This is particularly true with regard to the introduction of electric motors supplied with current from central stations. It appears that in 1890 there were 2,363 stationary electric motors in use in the whole State, of a total of 2,954 horse power; that 668 of these were metered, yielding an annual return of $67,550, and that 1,695 were supplied with current under contract, yielding $117,655.

These motors were, it would seem, about equally divided between the State and the city, the latter having 1,185 and the State 1,178, although, curiously enough, only 68 motors outside the city were on meters, showing the adherence to the earlier and less scientific method of selling power by a flat rate. If the figures had been further analyzed, it would be found that the motors outside New York City were grouped chiefly in one or two large centres of population, especially Rochester, Buffalo and Troy, not, however, forgetting Brooklyn.

It is difficult to get at the latest figures on the subject, as no close census is kept up, but the use of electric power has naturally increased greatly during the past five years, and probably the rate of growth has been as high in New York City as anywhere; although Chicago has made great strides, the Edison Company there having in 1894 a capacity of 4,210 horse power of motors connected to its mains, and having during the current year added a great many electric elevators. But, returning to New York, it may be safely estimated that there is a capacity of not less than 10,000 horse power of motors on the local circuits, which at an average of one horse power per motor would represent 10,000 motors in this city alone, to say nothing of isolated plants. The same ratio extended through the State on the basis of 1890, would give not less than 20,000 stationary electric motors of an average one horse power each in operation. The motors now, however, must average more than 5 H. P. each, and we take no account of the thousands of fan motors.

These figures would imply a healthy growth, and are likely to be greatly improved as time goes by, owing to the practice that is already prevalent of equipping whole factories at one sweep with motors in place of long lines of shafting and belting. But we wonder now and then whether the central station managers are all of them quite alive to the opportunities presented to them. There is not yet a clear perception of the fundamental fact that an electrical central station exists to sell current and not to market apparatus. A great many stations still deem it a good thing to make a profit on all the motors they place, and motor manufacturers have necessarily had very often to address their arguments to the manager or superintendent in order to induce him to display any activity. But the opposite and better tendency is beginning to make itself felt, and there are stations to-day which either leave the sale of the motors to supply houses or else place the motors at a price that gives the customer all the benefits. For example the Worcester, Mass., Electric Light Co., one of the most progressive organizations of the kind in New England, in

building up its day service, came to the conclusion that the one thing it had to sell as a permanency, was current, and that if it had to introduce new apparatus to help the sale of current, it would give the customer all the inducements it could. To-day, therefore, in Worcester, the buyer of a motor gets it practically at the price from the factory or the supply house. The motor becomes his property and he is therefore interested in its careful upkeep. Meantime, the local company has within a comparatively few months built up a day power load which reaches four or five hundred horse power, and which Treasurer Fairbanks informs us bids fair to increase steadily as a result of the plan adopted.

It is natural, of course, that a local company should exercise some control or supervision over the apparatus that goes on its circuits, but there its intervention, we think, might well end. It might be a good plan in smaller stations seeking a good day load to make it worth while for the superintendent to absorb the power patronage of the city by giving him a bonus on the increase of current consumption for that purpose, or on the horse power of new motors installed; but the main idea must assuredly be to get the motors into the hands of the users at as low a cost as possible, rather than to limit the market by adding to the price of the apparatus a long series of commissions, which after all no company anxious to extend its area of of current supply, ought to consider for a moment as an element in its work and policy.

MR. BOWEN'S PROFESSIONAL ETIQUETTE.

For some little time past considerable publicity has been given to the Columbia stove for car heating and to the remarkable data in its favor, as against electric car heaters, as presented after careful test by Mr. Menard K. Bowen, of the Chicago City Railway. More recently Mr. Bowen has been interviewed on car heating by the Chicago *Tribune*, and the same evidence against electricity is carefully brought forward. Now it is quite likely the Columbia stove is a good one, and quite likely that Mr. Bowen is an estimable engineer and superintendent; but we do think that the professional etiquette in this case might be a little higher and better. What we mean is that Mr. Bowen, while appearing in these statements as a wholly disinterested and studious expert on street car practice, is himself the patentee of the Columbia stove before which the electric car heater must hide its diminished head. Patent No. 529,158 on the Columbia stove was issued to Mr. Bowen on November 13, 1894; no assignment that we are aware of is recorded, and he is in all probability deriving a royalty from its use and sale.

Now, doesn't Mr. Bowen think it would have been nicer for somebody else to do the testing of his stove and to "crack it up to the skies?" As a matter of fact, he flies false colors and is guilty of deception, though perhaps quite unintentionally. Innocent people, getting his data on car heating, and not knowing his relationship to the subject, would very naturally be biased against electric heaters and believe the Columbia stove to be the one thing desirable. We have at least done our duty in undeceiving them, and we will add that Mr. Bowen's figures are a gross exaggeration of the facts in regard to electric car heaters, which are now known to be trustworthy and economical appliances and are being put in by trolley roads in batches of a thousand at a time.

ROUNDABOUT NOTES IN EUROPE.

In this issue we bring to a close, with regret, the bright and interesting series of articles that Mr. E. J. Wessels has been contributing to our pages, embodying his shrewd and suggestive observations of travel in Europe this year, and dealing particularly with the subject of electric traction. While all these articles have, as we know, been widely read and greatly enjoyed, we desire to call special attention to the "practical pointers" with which they close.

INVENTIVE ACTIVITY IN STORAGE BATTERIES

While on the one hand there has been a rapid concentration of control of most of the best existing types of storage battery, with a corresponding advance of the art industrially and commercially after the long and painful period of litigation and intimidation of customers, it is not to be supposed that there will be a cessation of activity in storage battery invention. On the contrary, such activity is likely to be pronounced, and for the welfare and greater perfection of the appliance is much to be desired.

After the announcement of Planté's discovery, among the first inventors who sought to improve his method was Percival. His secondary battery seems to form an intermediate step between that of Planté and of Faure. While in the Planté electrode the active material is formed by the disintegration of the plate or support, and in the Faure by the mechanical application of the active material to the support, Percival's electrodes were cells filled with conducting powders and divided by a porous partition, metallic slips in contact with the powders forming the terminal connections. Although an accumulator of such construction did not, we believe, then find commercial application, the type is still prevalent. In the Rooney secondary battery electrode described in this issue, the division of the support plate into laminations or rows of perforations, which in operation are of consecutively opposing polarities, and the resulting simplicity in the construction of sections, warrant Mr Rooney's belief that greater success may now be attained in the use of his type.

TROLLEY EXPRESS DELIVERY.

We give some interesting details this week as to the proposed system of trolley express delivery that is to be carried out in Newark. As is well known, the trolley freight service has so far been limited chiefly to the delivery of bulk freight between separate and remote points or depots; but in Newark, as doubtless in many other large cities, it is seen that a good opportunity exists for an ordinary parcel delivery system. This is what will soon be under trial, with many novel developments. It is worthy of note that some of the steam railroad men in New Jersey are meeting, resolving and organizing against this new departure, with an ultimate idea probably of nominating Col. Hain for the presidency of the United States on a new Know-Nothing platform. Mr. W. E Curtis in his article in our columns this week, on electricity in China and Japan, tells how a steam railroad was ripped out by certain Chinese New Jerseymen, one reason being that it threw some junks out of employment, but the main cause being obviously that it was new and progressive. Another interesting freight development we note this week is the scheme promoted by the manufacturers of New Haven, for the haulage of their raw material and finished product to and from the Consolidated Road.

ELECTRIC TRANSPORTATION DEPARTMENT.

THE POTTER HIGH POTENTIAL RAILWAY SYSTEM.

A high potential electric railway system, especially adapted to long distance lines, has recently been suggested by Mr. William B. Potter, of Schenectady, N. Y. It includes the adaptation of the three wire system to railway work, using a potential of from 1000 to 1200 volts between the positive and negative mains, and, at the same time employing standard apparatus designed for a maximum voltage of 500.

To accomplish this end, Mr. Potter employs four 500 volt motors, two upon each side of the system. Two generators in series are employed with the connection between them grounded, the earth and rails of the track being employed as the neutral of a three wire system. At no time, however, is the main current allowed to flow through the earth or rails, the path of the current being first through the two motors to a common ground connection from the main having five hundred volts positive potential and then returning by the other line at five hundred negative potential. Only where one pair of the motors would be slightly out of balance with the other pair would any current at all flow in the neutral.

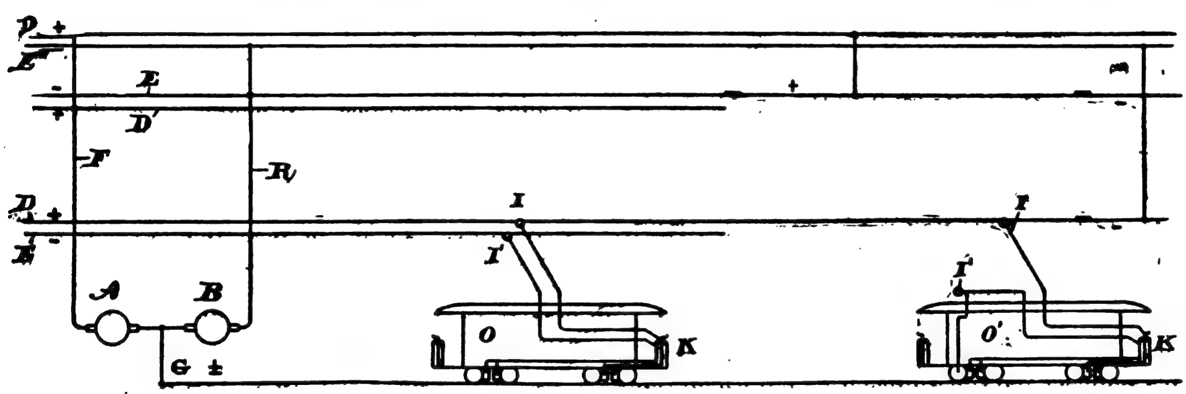
By this arrangement bond wires may, it is claimed, be either dispensed with altogether or replaced with very light ones, at a great saving of expense in copper.

Double trolleys are used with this system for long distance work, but where the lines enter the city limits, the apparatus is so arranged that one trolley may be withdrawn and the motors operated all four in series between one of the trolley lines and ground as usual.

The accompanying illustration shows diagrammatically a road equipped for both a three-wire and a city system, with a car on each part. As will be seen, A B are the generators having a common ground connection G to the track, serving for the neutral main of the three-wire system. D D are the positive mains or conductors and E E are the negatives.

The positive conductors are at five hundred potential plus, while the negatives are at five hundred potential minus, the ground being taken as zero. The feeders are also shown marked D[1] E[1], respectively. The leads from the generators F R connect with the positive and negative working conductors.

The cars, O and O[1] are running upon the three-wire and two-wire parts of the system respectively. They are both provided with two trolleys, but trolley I[1] in each case has a switch, S which is operated by the act of pulling down the trolley.



Potter's System of Interchangeable Wiring for Electric Roads.

THE FACTORY FREIGHT TROLLEY FOR NEW HAVEN.

An important project for the benefit of the City of New Haven, is embodied in the plans of the Manufacturers' Street Railroad Company. Its officers are: President, George S. Barnum of the Bigelow Company; Vice President, Nathaniel W. Kendall, President of the Quinnipiac Brewing Company; Secretary, Frank L. Bigelow, and Treasurer, Col. S. J. Fox of the National Pipe Bending Company. These gentlemen are the framers of a plan for connecting the manufacturing plants in the Grapevine Point district with the Consolidated road, and thus saving a great outlay for carting raw and manufactured material.

"All of the manufacturing companies will give the right of way," says George S. Barnum, the President of the company. "Why shouldn't they?" he continued. "Isn't it for their interest to have this railroad right at their door? If our company (the Bigelow Company), with all its extensive buildings and machinery, were offered the property we occupy, as a gift, we to erect the present building and there was no railroad nearby, we would not not accept the offer. But there are a great many factories in this district, enterprises beginning in a small way and gradually growing to their present proportions and these concerns need this proposed railroad. All will have exactly the same privileges. The building of this road will not only benefit these manufacturers, but others will locate along the line and vacant lots will be built upon. Already I know of a couple of companies that will locate here if this road is built. There are some obstacles in the company's way, but the road will be built in the spring. All property in this section will advance when the road is built. It is just what is needed to advance the interests of this section of the city and in fact for the entire city."

Frank E. Williams, Assistant Treasurer of the New Haven Rolling Mill Company, said the new railroad would save 75 per cent. of the present cost of carting materials to and from the factories. It might prove something of a loss to the truckmen, but would be a benefit to the manufacturers.

"I understand it will cost about $3 per car to run to and from the junction with the Consolidated road," said Mr. Williams. "And the carting would cost at least four times that sum. Our company alone ships 20,000 tons of iron a year, and if we can ship direct by rail, it will prove a great saving. I understand that at least three-fourths of the people over whose property the line will go, approve of the plan and the city also approves. The railroad will prove a great benefit in this section of the city and will do a great deal towards building it up. It will open up new property for manufacturing purposes and lead to developing all this water front. I can see no objection to the enterprise and it will prove a very great benefit to the manufacturing enterprises."

It is proposed to use a heavy motor trolley car for hauling the freight cars. Sufficient power could be secured from one of the electric road lines, if the company did not see fit to establish its own power house. For the present at least, the company will depend upon the ordinary freight cars of the Consolidated road for the shipment of goods from the factories.

THE HICKLEY REVOLVING TRACK BROOM.

Next to a good track itself, a clean track is necessary in order to get the best economy in power required for traction and to secure easy riding for passengers. With these points in mind, the Hickley Launch and Manufacturing Co., of Asbury Park, are now bringing out a new type of revolving track broom. These brooms are round, about 2 feet in diameter, and about 6 inches thick. They are placed directly over each track in front of the car, but instead of being directly parallel with the rail they are on a slight angle, so that as the car moves, these brushes revolve by friction upon the ground, the motion caused thereby brushing snow and dust off the track.

Stamford, Conn.—Vice President Hall of the New York, New Haven and Hartford Railroad Company says that the Stamford and New-Canaan Branch, recently purchased, and about eight miles in length, is to be equipped with electricity.

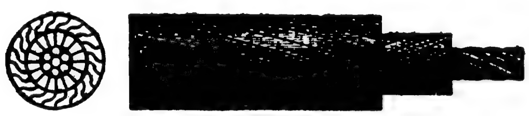
LAMB'S ELECTRIC CABLEWAY ON THE ERIE CANAL.

In THE ELECTRICAL ENGINEER of Oct. 30, appeared a full and illustrated article on the application of the Lamb electric cableway to canal boat haulage on the Erie Canal. In addition to what was then stated, it may be added that the Lamb motor and cable hauled as many as five boats along the line, loaded down with people, at a speed of four and seven tenths miles per hour. The motor did not warm up on the down trip, and the electrical and civil engineers present were delighted with the success of the test. One thing that was especially noticed by them, and commented on, was that as the motor approached a given point it did not pull the sag out of the lower or towing cable to the extent of making it taut for a distance to exceed one span ahead of the motor, thus showing that any number of motors can be operated on one line, all pulling in the same direction, and it will not influence the cable but a few feet ahead of it.

Following the test, State Electrician Barnes expressed himself as follows in regard to it:

"I have this day witnessed the test of the application of electricity as a motive power for the propulsion of freight boats on the Erie Canal at Tonawanda. The entire success of the experiment is exceedingly gratifying to me, as I have been engaged with electrical affairs exclusively for the past twenty years, and I was present as Electrician in behalf of the Superintendent of Public Works of this State in the fall of 1893, when the first experiment was made at Brighton to propel canal boats by power generated by electricity; and I have during a considerable period been looking forward to and expecting in the near future, the successful solution of the problem of the application of electricity as a motive power on our waterways, in such a cheap, convenient and certain form as would commend it to shippers and boatmen and induce its immediate use for that purpose everywhere, and particularly upon the canals of this State.

"I have no hesitation in saying that the test was entirely successful, and demonstrated to my mind the fact, that it may and



BEARING CABLE FOR LAMB SYSTEM OF ELECTRIC HAULAGE.

will be applied generally upon the canals of this State, and that it will result in very materially cheapening the cost of canal transportation as well as increasing the speed of boats. Taken in connection with the proposed improvement of the State canals, it will result in greatly increasing the capacity of the canals for transportation purposes, it will cheapen the cost of same, and it will thus increase the power of the canals to control the freight rates between Buffalo and tidewater.

"The cheapness at which the electrical power can and will be furnished from Niagara Falls for this purpose is assured by contracts already made by the traction company engaged in making the present experiment, and with a wise and prudent management, I am sure that all the results I have predicted, must follow.

"In what I have said in relation to the plan adopted in the test at Tonawanda, I do not mean that the particular plan or machinery there used is the only or best one which ingenuity may devise in the future, but I do mean to be understood that this particular plan is simple, cheap, can be readily and cheaply applied to the present canal boats and will successfully do the business."

We illustrate herewith the Lamb cableway cable, which as already stated bears the weight of the hauling motor. This cable has a copper core and a steel sheath. It is $1\frac{1}{4}$ inches in diameter, has a weight per foot of 3.67 pounds, and will stand a breaking stress, approximate, of 67 tons. Its conductivity is equal to that of three No. 0 wires.

ELECTRIC PROPULSION AND ELECTRIC HEATING ON THE BROOKLYN BRIDGE.

The trustees of the bridge have taken final action in regard to the introduction of electricity in place of the locomotives now used in switching the cars in both terminals. President Howell and Trustees Page, Keeney and Henriques, composing the executive committee, met at the bridge offices last week and discussed the question. The meeting was an executive one, and at the end President Howell said that the following resolution had been unanimously passed:

Resolved, That the chief engineer be instructed to advertise for proposals for switching the cars by electricity, and that the same be accompanied by plans and specifications showing how it is to be done.

Furthermore, be it resolved, That bids for heating the cars by electricity be also advertised for and that all the aforesaid bids be received by 12 o'clock noon of November 11, 1895.

President Howell said that this was the fairest way, as it gave all the different companies who wanted to put their systems on the bridge an even chance. The present cable will be abandoned and electricity substituted if this experiment proves successful and gives satisfaction. During the past two months the trustees have examined many different systems of the various companies and although most of them agree that one of them is the best, they have decided that the fairest way would be to receive bids. The matter will be decided after the bids are opened at the next regular meeting of the trustees on November 11.

ELECTROLYSIS OF WATER AND GAS MAINS.

At the meeting of the International Association of Fire Engineers held in Atlanta, Ga., October 7, the committee of experts on the subject of "Electrolysis," of which committee Morris W. Mead, superintendent of the Pittsburg bureau of electricity, was a member, submitted its report. The other members of the Committee are Wm. Brophy, John P. Barrett and B. S. Flanders. After discussing the trouble, they say:—

First—Have determined at once whether the rapid corrosion of the water pipe is going on, due to this cause, and to what extent.

Second—To take immediate steps to stay its progress.

Third—Use all your influence in preventing companies and individuals from procuring a franchise to build and operate electric roads equipped with the overhead single trolley system.

Fourth—Serve the community, and protect yourselves, by warning those in authority that the water system may fail you at a most critical moment and completely paralyze your efforts to stay the progress of the flames.

Fifth—That gas pipes may become so weak from this cause that they will pour their contents into the soil, dwellings, stores, warehouses and factories, to such an extent as to endanger these structures and the lives of the inmates as well.

Having done all this, you will have performed your whole duty; and if your note of warning is not heeded, the responsibility for possible future disaster will rest on the shoulders of those who blindly invited it.

FIGHTING A BROOKLYN SLOW-SPEED ORDINANCE.

THE Brooklyn Heights Railroad Company has begun a suit in the Supreme Court, in Brooklyn, before Justice Cullen, against the validity of the city ordinance regulating the speed of trolley cars. The ordinance which the company is fighting was passed April 1 last, and declares that "no street surface railroad car, operated by electricity in any of the streets, avenues or public places in the City of Brooklyn, shall be run at a rate of speed to exceed six miles an hour within a radius of one and one-half miles from the City Hall, or within a radius of two miles of the Broadway ferries, nor in any other part of the first twenty-eight wards of said city, at a rate of speed to exceed eight miles an hour."

Council for the railroad company hold that the Common Council has no power or jurisdiction to adopt such an ordinance, and that it is a violation of the terms of the grant of Jan. 11, 1892, which authorized the company to run its cars at such rate of speed as should enable it to secure better transit to the public, not to exceed ten miles an hour.

The city's lawyers claim that the regulation is reasonable, and that it was adopted by a body legally empowered to make city ordinances.

AN ELECTRIC FEEDER FOR THE CHICAGO METROPOLITAN ELEVATED.

The suburban electric road to be built in Cicero and to connect numerous suburban towns will be a feeder to the Metropolitan Electric Elevated. Interests friendly to the latter are in charge of construction, and cars are building on the same specifications as those of the Metropolitan Road, to run down town over its tracks. It will have twelve to fifteen miles running by July of next year. A large public meeting of west side residents was held in West Lake Street last week to protest against the proposed elevated loop on the ground that it concentrated business down town.

NEW MILWAUKEE TROLLEY CAR.

The Milwaukee Street Railway company intends to construct for the use of trolley parties a special car that will have some decidedly new features. It will be about thirty-five feet long, enclosed entirely with wire rails, and have no entrance except through gates at the ends. It will be supplied with portable chairs instead of the usual seats, and have small portable tables. Arrangements will be made for furnishing refreshments while the car is on its trips. A double row of incandescent lights will extend around the interior of the car, while the number of decorative lights that may be placed on the outside will be large. There will be room for attendants, waiters and even music.

SOME DATA AS TO THE USE OF STORAGE BATTERIES FOR RAILWAYS IN AMERICA AND EUROPE.

BY MAURICE BARNETT.

In these days when it is the practice of not a few eminent electrical engineers to damn the storage battery in the field of traction, either by too vehement denunciation or by "too faint praise," the announcement in the *Kolnische Zeitung*, that the trolley system which has been in use in Hanover for some time has been discarded, and that the twenty-eight cars operated on that system are to be remodelled and equipped with storage batteries,—while not conveying solace to the electrical engineers referred to, will prove very gratifying to those, who, even in view of some discouraging failures in accumulator traction, have always had a firm conviction that traction work was a legitimate field for accumulators,—and that the test of time would prove that storage batteries would be able to hold their own with other representative electric traction systems.

Since the announcement in the *Kolnische Zeitung*, news has been received here that the "Dresden Tramway Co." and the "Hague Tramway Maatschappy" have likewise decided in favor of accumulator traction. Inasmuch as no less important a company than the Tudor Storage Battery Company is making the installation, it is not at all too optimistic to believe in the ultimate success of the storage battery cars about to be operated in the above named places.

Up to the present time, the engineers of the overhead system have had matters pretty much their own way. Occasionally a statement of results (coming in all probability from interested sources) bearing upon the success obtained with the open conduit has caused a commotion in the trolley ranks; but, save for that, the erection of poles has gone merrily on and the manufacturers of trolley machinery have had no complaints to offer on the ground of lack of orders. The past two moths, however, have seen the beginning of a mighty change. To-day the trolley is considered to have been merely coincident with the evolution of the modern passenger railway, and hence its usefulness in the future, at least in cities, is not likely to be greatly overestimated. E. H. Johnson, who, with Lieut. F. J. Sprague was the pioneer in working out the trolley method of electric transportation, writing in THE ELECTRICAL ENGINEER under date of October 9th, sounds the doom of the overhead line at least in cities and towns. The reason for this belief is to be found in the objection to overhead construction and secondly in the fact that greater economies are possible in the newly projected closed conduit system, by reason of the fact that higher voltage may be maintained than is practicable in trolley systems. This criticism emanating from one of the parents of the overhead wire system may be considered to have some weight. Mr. Johnson also proceeds to pay his respects to the open conduit system anent the great ado made by the Metropolitan Traction Co. of New York, "over the practical success of their $150,000 per mile open conduit system," by saying, "it was neither sientific nor businesslike to place the electrical conductors in a sewer and then expend hundreds of thousands of dollars to secure drainage." This represents the view that is at present held respecting the open conduit electric system. Surely the friends of the electric accumulator can take hope in the discomfiture of their rivals!

Looking impartially at this question, it would seem as if the contest for supremacy in the field of transportation would in the future, be between the *Storage Battery* and the *Closed Conduit Systems*. Which side will win cannot be conjectured at the present time. Neither system is in the final form it will assume when the contest for supremacy takes place, and one is therefore precluded from indulging in prognostications regarding the outcome.

The above remarks have been called forth by statements appearing from time to time in some of the newer electrical journals, reflecting upon the judgment of those who are instituting the test with storage battery cars on the Madison Avenue line in New York City. The remarks have all been characterized by a sneering incredulity as to the value of accumulators for traction work. Before the next six months are passed, the critics of the storage battery system may have to reverse their conclusions.

The object of the present paper is to emphasize the great value possessed by storage batteries,—not in furnishing direct motive power, but when used in connection with railway power plants.

The first accumulators used in connection with a railway power station were, so far as the writer can ascertain, those employed in the power plant of the railway lying between Zurich and Hirslanding, Switzerland,—an account of which was published in the *Elek. Zeitschrift* of June 28th, 1894. According to report the dynamo delivers current under a constant load, the accumulators being charged or discharged as load on the line is less or greater than the output of the dynamo. In this plant there were automatic means for cutting in and out of end cells to keep the voltage constant. Results showed that by means of the accumulators a saving was effected of 2.2 pounds of coal per H. P. hour, amounting to nearly a ton per day, or $2,500 a year. The cost of accumulators, installed complete with necessary apparatus, was $7,400. Allowing for interest and depreciation the battery paid for itself in four years, by saving in coal bills alone. The saving was effected by reason of there being no necessity to keep a second boiler and steam engine in reserve,—and that by this arrangement the power plant ran at its highest efficiency. It was furthermore developed that the first cost of combined steam power and battery plant was less than the cost of the total steam power plant would have been for the same work.

How important this installation proved may be judged from the fact that a single type of storage battery is now found in Germany and Austria, in 80 per cent. of all central stations,—besides being installed in fifteen railway power plants and 5,000 isolated lighting plants.

Two railways in the United Kingdom have recently attracted a great deal of attention; and inasmuch as the batteries used in connection with generators are of the Chloride accumulator type,—manufactured by The Chloride Electrical Storage Syndicate, Limited, the installations have a special interest for American railway managers. These two railways are known as the Douglas-Laxey Line and the Snaefell Mountain Electric Tramway, both in the Isle of Man.

The Douglas-Laxey Line was established about a year ago. From the September 19th, 1895, issue of *Lightning*, London, it is gathered that when the battery was connected to the line, the cars immediately began to run with exceptional smoothness—the accumulators keeping the voltage steady and eliminating all sudden variations due to the starting of other cars. How variations would otherwise arise will be understood when it is considered that it requires 150 amperes at 500 volts to carry a loaded car up the 8½ per cent. grade at a nine mile rate.

Encouraged by the success attained by the Douglas-Laxey electric tramway, which after a year of service "had fulfilled in every way the expectation of its promoters," it was not difficult to secure capital to construct an extension of this road up to the summit of Mount Snaefell. The electric equipment of the Snaefell road resembles that of the Douglas-Laxey Line, both being designed by no less eminent an engineer than Dr. Edward Hopkinson. The battery consisted of 246 special cells. At 550 volts, the battery furnished 176 amperes for three hours, 112 amperes for six hours, 84 amperes for nine hours and 72 amperes for twelve hours. By evening up the load on the generators, the battery enabled the plant to work at a high efficiency and rendered the service extremely satisfactory.

A large economy is made possible by a special use of battery at seasons of the year when there is comparatively little traffic. Under the agreement with the authorities, these lines bound themselves to run two cars a day each way every day of the year. Obviously, it would not have paid to keep the power house in operation just for this load. This is where the battery proves so valuable, during the winter months. The battery being charged once a week can carry the load for the other six days without necessitating the running of the power plant.

In the United States there are two installations of storage batteries in connection with railway power plants, which are of special interest. The first is at Merrill, Wisconsin, where a battery of Chloride accumulators was installed to effect a solution of the problem so constantly occuring in the railway world, *i. e.*, how to bring up the capacity of the power plant to meet the requirements of a constantly increasing demand. It was decided to use a battery not alone for increasing the light capacity, but for regulating the voltage on the railway circuit which,—according to the engineer who installed the plant,—"was far from satisfactory owing to the great fluctuations in railway demand." As the lighting machine and railway generator were connected to the same shaft, it can be understood that the light furnished was far from satisfactory. Records kept before the battery was installed showed a fluctuation as high as nine volts on each side of the 3-wire system. Mr. Herbert Condict in a paper, descriptive of this plant, read before the Northwest Electrical Association, at their last convention, spoke of the performance of this battery as follows:—"The great improvement in running of cars was immediately noticed by all, but it was at night that the contrast was most apparent. The two water wheels were connected together as usual, but the railway generator charged the battery at almost a steady rate instead of with its ever varying demand of from 0 to 120 amperes per car. * * * * Instead of a succession of sharp peaks the voltage curve of the lighting circuit became practically a straight line; instead of nine volts variation, there was practically no variation, demonstrating most clearly the capability of the battery to respond to all demands of railway, no matter how severe."

The second plant mentioned is now being installed at Anaconda, Montana, for The Electric Railway, Light and Power Company, of that place. The battery consists of 270 special cells of central station type of 600 ampere hours capacity, but admitting of very heavy discharges. The object of the battery is to even up load on generators and maintain constant E. M. F. When the battery goes into operation it will be found to give results no less satisfactory than those obtained with the Merrill plant.

To sum up, it may be said that the storage battery is destined to play a very important part in the future in light, heat and

power stations. The reason for this statement is to be found in the ability of a good storage battery to act:

First: As a "reservoir" in which may be stored up the energy representing the difference between the average and the maximum demand on a generating plant.

Second: As a regulator of pressure on circuits subject to fluctuating demands—increasing the efficiency of the service and diminishing the wear and tear on apparatus, and

Third: As a "transformer," to utilize high voltage, charging currents and to discharge, when disconnected from generator, at any lower voltage desired.

One fact that has been demonstrated, and which has the most important bearing on the construction of electric railway power plants, or for that matter, of most electric light or power stations, is that in any station which has to meet a fluctuating demand for power, a plant consisting of part steam power and part storage battery is cheaper in first cost than total steam power plant would be for the same work. The high efficiency and satisfactory performance of such a plant has already been referred to.

CONEY ISLAND TROLLEY SIGNALS.

THE new electrical signals erected by the Smith Street and Coney Island Trolley Company across the Boulevard, Coney Island, to warn wheelmen, carriage and other vehicle drivers that a car is approaching, have been tried and found to work successfully. The signals are three electric lights over the driveway and two electric lights over the bicycle path, all with red globes. When the approaching car is twenty-five feet away on either side of the Boulevard it passes over a small switch which rings a gong notifying the motorman to bring the car to a full stop, and causes the lights to burn for five seconds.

The many wheelmen and driving parties who go down to the Island, are enthusiastic and loud in their praise of the new signals. The motormen are also much pleased. The signals on the darkest and most foggy night can be seen up the Boulevard half a mile.

CARD'S IMPROVED FUSE BOX FOR STREET RAILWAYS.

THE accompanying cuts show Card's improved fuse box for street railways, manufactured by the Card Electric Company, Mansfield, Ohio. Fig. 1 shows the slate box without metal case.

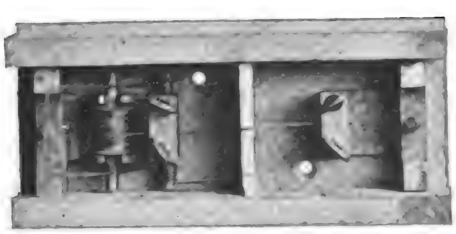


FIG. 1.

It is well adapted for use on cars when placed under the seat or in some other protected place. It is made up with a slate bottom and sides and has brass binding blocks at each end for securing the connecting wires to. At one end is a small spool, on which is wound a length of the fuse wire selected. The wire passes from

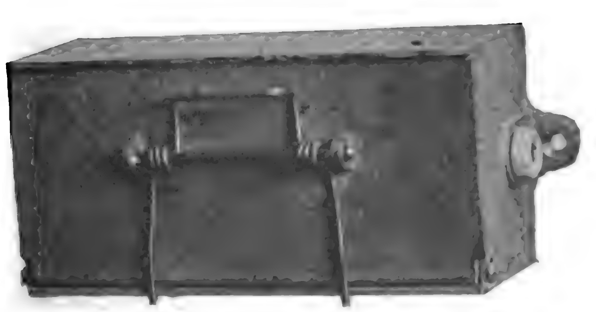


FIG. 2.

the spool under a clamping piece on the binding block, through a slot in the slate partition and under another clamp on the opposite binding block, completing the circuit. Fig. 2 shows the slate box in a metal case, for use on the outside of cars. The lid closes tightly and the box has a projection along the top, making it water and snow proof. A folded piece of asbestos slips inside the box along the sides, over the fuse, insulating the lid. Fig. 3 shows the box with the front open, exposing the fuse. The spring on the outside of the lid acts to hold it either closed or open.

When a fuse blows all that is necessary to do is to loosen the thumb-screws, pull through more wire and clamp it down. Each

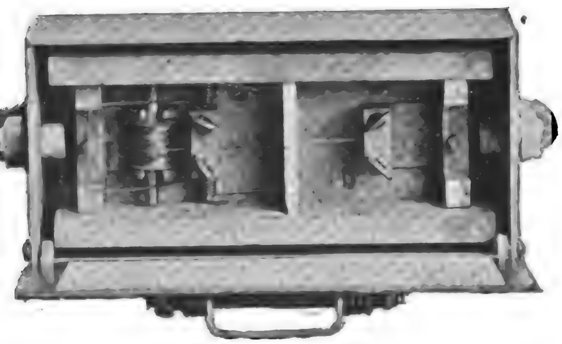


FIG. 3.

spool will hold 35 feet of No. 21 copper wire, enough for 100 50 ampere fuses. When the wire is used up the empty spool can be taken out and a full one put in without loss of time. As the proper size of wire to use depends largely on the grades, service and the motors, it should be determined by the superintendent and then adhered to. This method will save burn-outs, time and money.

SCHUYLKILL ELECTRIC RAILWAY CO.

Deputy Sheriff Henning of New York, has received an attachment for $25,000 against the Schuylkill Electric Railway Company of Pennsylvania, in favor of Anthony F. Holahan on an assigned claim of Charles E. Smith for 5 per cent. commission for services in connection with the sale of $500,000 first mortgage bonds of the company.

THE TROLLEY THRILL.

THE officials of the Traction company, according to the Bridgeport, Conn., *Post*, say that it is the most respectable and ordinary quiet people that make the loudest noise on trolley parties. When you see a car go through the streets laden with a crowd that emits fearful screechings from tin horns, and yells that would stupefy a Comanche Indian, you know it is a party of Christian Endeavorers or a lodge whose motto is peace, love and quietude.

AN UNDERGROUND TROLLEY IN ST. LOUIS.

St. Louis is to be given a fair test of an underground trolley system. The People's Line will be the pioneer in this movement. Mr. Green, President of the People's Railway Company, attended the recent meeting of street railway officials in Montreal, and afterwards went to Washington, D. C., to look into the underground system. He was very much pleased and says that he will begin work next spring making the change. The People's is one of the longest roads in the city, and difficulties will confront it that neither New York nor Washington managers encounter.

ANOTHER TROLLEY LINE IN CONNECTICUT.

The contract has been let for the extension of the Hartford and Manchester Electric Road to the city of Rockville. The new line is to be built during the coming two months and operation will begin next spring. It will compete in passenger traffic with the New York and New England, which reaches Rockville by a branch line.

NEW ELECTRIC ROAD FOR BUFFALO.

The Buffalo Traction Company has been incorporated to construct a street surface railroad sixty-six miles in length, to be operated by electricity. The road is to be constructed from the Buffalo City line, at South Park, and from the City Ship Canal, in the Hamburg Turnpike, to the Buffalo City line, in O'Neill Street, and across the City of Buffalo to the Pine Hill road, in the town of Cheektowaga, which places will be its termini. The capital is $3,000,000, and the directors are F. G. S. Miller, Joseph B. Mayer, Leonard B. Crocker, Washington Bullard, and Herbert P. Bissell of Buffalo, Tom L. Johnson of Cleveland, Ohio; Richard Ladenburg, John E. Page, and Louis Kahn of New York City.

ADVANCE OF THE B. & O. ELECTRIC LOCOMOTIVE.

96-ton electric locomotive has now been in operation on the Belt line of the Baltimore and Ohio Railway, since August 4th last, hauling the entire North bound freight service of that railroad. Every train has been handled promptly and the locomotive has been ready at any and all hours during the day, causing no delay to traffic. Nothing has occurred to interrupt the excellent work of the locomotive which has responded to every call without failure either of speed or power.

A few weeks ago a test was made to learn its capacity for running a loaded train on an up grade. For this purpose a train consisting of two steam locomotives, not working, and twenty-seven loaded freight cars, was brought to a stop while going North through the tunnel. Here the grade is 42 feet to the mile and the rails were damp and greasy. The weight of the train alone was 1,125 tons, or 1,221 including the electric locomotive. Every drawbar was tight, no slack occurring throughout the length of the train. In this condition current was turned into the motors and movement was immediately communicated to the train. At the end of one minute, the train was moving at a speed of ten and one-half miles an hour and at this point the speed was increased to the usual rate. The total distance moved in 40 seconds was 150 feet, and at the expiration of one minute 450 feet.

A few days ago a test was made with a dynamometer car placed between the electric locomotive and the train, which consisted of twenty-two cars loaded with coal, one caboose and two dead locomotives. The total weight was 1068 tons. On the 10 per cent grade in the tunnel, an average drawbar pull of some 25,000 lbs. was obtained from the dynamometer diagram. The speed at this point was 11½ miles per hour. Comparison with the diagrams obtained in similar service with steam locomotives showed a remarkably uniform and steady pull by the electric engine, due to the absence from it of reciprocating parts, the torque being constant throughout the entire revolution of the wheel. As the capacity of the dynamometer car was only 26,000 lbs. when accelerating the train the drawbar, of the car came up against the safety stops.

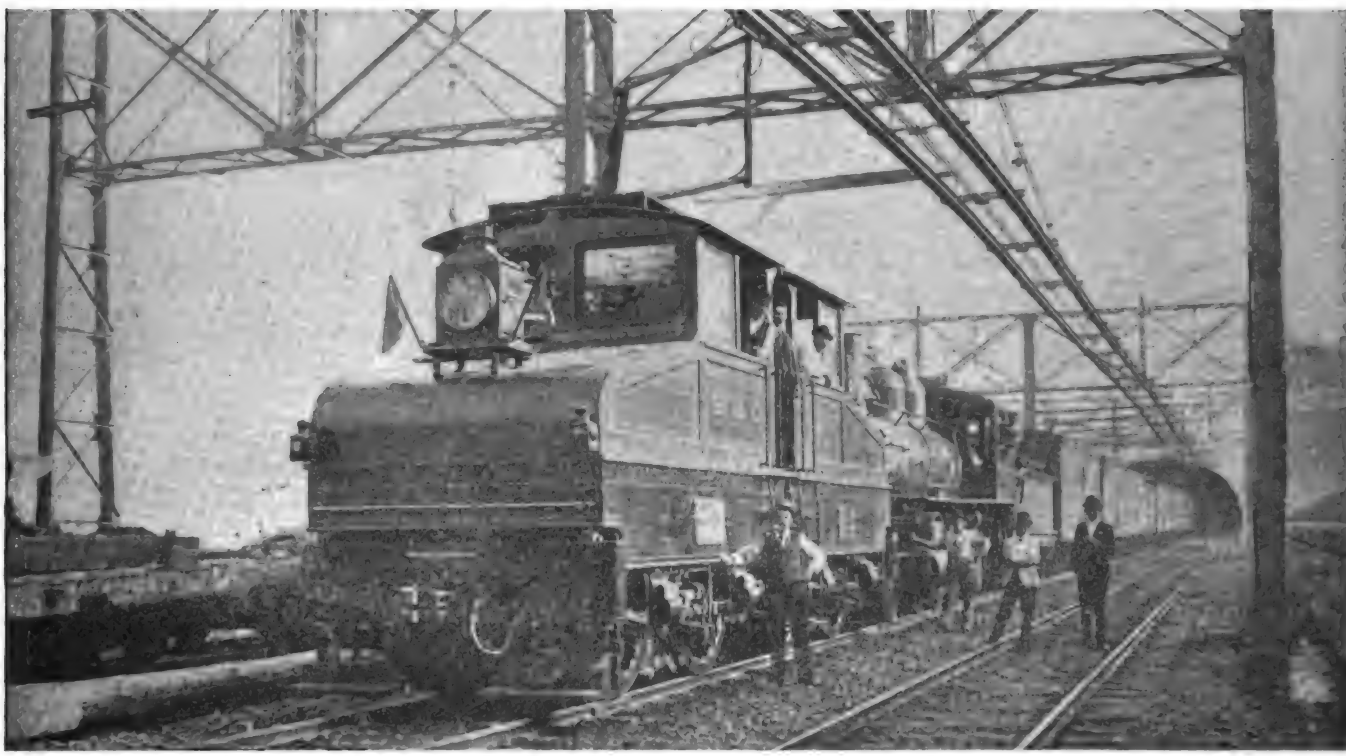
A further test was made with another train, consisting of 36 cars, one caboose and three dead engines. This was a regular through freight train with a local freight attached, and the total weight was in excess of 1600 tons. It was hauled with ease through the tunnel, and calculation from the previous dynamometer records and the drawbar pull per ampere, showed a drawbar pull of over 45,000 lbs.

A test made on October 6th has added a new record to the list of remarkable performances of this locomotive. The character of the performance is heightened by the fact that the train which it moved measured over 1,800 feet long and weighed about 1,900 tons and was started from rest in the tunnel. It consisted of a North bound freight train of twenty-eight loaded cars and two locomotives coupled to a local freight of fifteen loaded cars and one locomotive. In starting, not a sputter, spark or slip of the wheels occurred and the train moved with the same precision as if the circumstances had been of the ordinary character. The drawbar pull of 60,000 pounds was about the record in this case. The train was quickly brought to a speed of 12 miles an hour and pulled through the tunnel without difficulty, with the locomotive continuously exerting a drawbar pull of 40,000 pounds.

Up to the present time no train which would hold together has been found heavy enough to cause the electric locomotive to slip its wheels under ordinary fair conditions. The capacity of the locomotive has been by no means reached. The tests have only shown approximately what the locomotive can do. A dynamometer car of sufficient capacity to test the maximum drawbar pull will shortly be secured, when definite figures can be obtained.

An extension of the overhead work of the electric equipment north to Waverly is being planned by the Baltimore and Ohio Railroad Company. The extension would secure the service of the electric locomotive on the grade from North Avenue. It is also contemplated to build south to Baylies, where housing for the electric locomotives will be built. The one now in use is at present side-tracked in the open air when not making runs.

The two additional machines ordered by the Baltimore and Ohio Railroad are nearing completion at the works of the General Electric Company at Schenectady, and when finished the passenger service through the tunnel will be undertaken by them.



THE ELECTRIC LOCOMOTIVE AND FREIGHT TRAIN LEAVING THE NORTH EXIT OF THE TUNNEL.

MOTORMAN'S "GONGOLYSIS."

SEVERAL employees of the Pittsburg electric lines have expressed themselves as being pleased with the remarks made by a locomotive engineer who was quoted in the railway columns a few days ago as condemning the ineffective gongs that are being used on electric lines in most cities. One of the motormen on the West End line declared that the article in *The Post* was timely and pertinent, and that the city authorities were negligent in not compelling the traction companies to provide a better signal. Another strange fact revealed by inquiry among the employees of the various lines was that the continual pounding of the gong has such a peculiarily injurious effect upon the men that many of them are at present laid up, and the symptoms in each case are so similar that the physicians are about to define their complaint under a new word in the category of diseases which may possibly be denominated as "gongolysis." It is said that three men on one line have been permanently disabled by ruptures of a peculiar form occasioned by the continual shocks, imparted to certain parts of their body from incessantly pounding upon the gong w th their heels.

A "LIGHT EXPRESS" TROLLEY SERVICE FOR NEWARK, N. J.

Newark will probably be ahead of the rest of the country in doing a light express business by means of trolley cars. The electric railroad has already been used as a means of facilitating the shipment of goods from point to point, but managers everywhere have hesitated about doing local express business because it will always be impossible to deliver packages directly from the cars without causing a delay to passenger traffic. There is nothing, however, to prevent the establishment of receiving and distributing offices at the ends of each line and wherever sidetracks are permissible.

The Consolidated Traction Company has made an arrangement by which the United States Express Company will do business over the various lines in special cars built for the purpose, and six of the cars are now being built in Philadelphia by the J. G. Brill Company for the experiment. They will be roomy box-cars, equipped with a trolley, and it is proposed to trail a passenger car behind each of them. By means of these cars the express company will be able to do business in every town entered by one of the trolley lines, and it is hoped will pick up considerable business which is now done by individuals who drive express wagons to places like Irvington, Belleville, Bloomfield, Montclair and Caldwell, as the system is extended. It is an entirely new branch of the express business, and must necessarily be developed by trial before any rules can be formulated for it. It is promised by the Traction Company that the express cars will never be permitted to delay or interfere with passenger traffic.

General Manager Young of the Consolidated Traction Company, when asked about the company's plans to inaugurate a trolley express service, said: "We wish no conflict with the city, and I do not think that any will occur, for the City Council must realize that we are not overstepping the provisions of our franchise. The franchise gives us the right to carry 'people and property,' and contains no proviso that the passenger must accompany the property. This discussion will all end as soon as the express service is begun, for the public will at once realize its advantages and utility. At present a man wishing to reach Jersey City or other nearby points with, say, fifty pounds of legitimate express matter, boards a car, inconveniences all the other passengers, and worries himself. Under the new express service, he may place his baggage on an express car, board the next passenger car, and he and his baggage will arrive at their destination at about the same time, and without any bother or trouble to anyone."

Opposition to the trolley companies of New Jersey in carrying freight took shape at Newark, N. J., on Oct. 25 by the organization of the Steam Railroad Men's Protective Union of New Jersey. The following officers were elected: President, D. E. Chapin, Newark, Delaware, Lackawanna and Western Railroad; vice-presidents, Thomas H. Joiner, Burlington, Pennsylvania Railroad; Charles H. Houston, Somerville, New Jersey Central Railroad; Joseph F. Galvin, Jersey City, Erie Railroad, and P. J. Dyer, Paterson, Susquehanna Railroad; secretary, Charles A. Kendig, Hoboken, Delaware, Lackawanna and Western Railroad; treasurer, E. E. Robbins, Millville, Camden and Amboy Railroad.

LULL IN ELECTRIC RAILWAY WORK IN CONNECTICUT.

A SPECIAL dispatch of Oct. 24, from New Haven, says:—Scattering reports for the summer quarter received from the electric railroad companies of this state show generally a large increase of business over last year, which is particularly marked in the lines running to the seashore. Nevertheless, there is a singular stagnation in new construction, and at the present time hardly a mile of electric roads is building out of new ones chartered over distances over not less than 400 miles altogether, of which a large proportion is in the cities. The check on construction is attributed to several causes, among them—besides exhaustion of the most promising territory—the disposition of cities and towns to tax new roads if laid out on streets or highways, the opposition to surrendering country highways at all, and the electric plans of the New Haven Railroad Company, which affect several important centres where large extension of electric service had been meditated.

Under the old law for returns, by a flaw in the statute, the street railroad companies were ordered to hand in returns to the railroad commissioners only one day later than the fiscal year which the returns were to cover. In consequence, few returns were made, and those almost worthless.

The last Legislature changed the law so as to compel returns on the 1st of November for a fiscal year ended on the 30th of September. The returns must be sworn to, and there is a penalty of $25 a day for neglect or refusal to make them. Consequently the coming report of the railroad commissioners will contain the first returns of any value from the street railroads of the state, which have almost 300 miles of single track. A very large number of them have been built from the proceeds of bonds, with little or nothing paid in on the stock, and the showing which will be made on "stock issued for cash" will be a very interesting one.

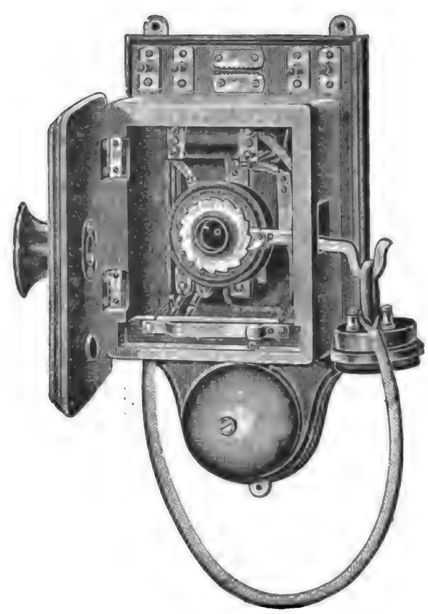
TELEPHONY AND TELEGRAPHY.

GENT'S AUTOMATIC REVOLVING TELEPHONE TRANSMITTER.[1]

BY W. PERREN MAYCOCK.

IN transmitters of the granulated carbon or Hunnings variety, the carbon is apt to cake or wedge at the bottom, and speaking is thereby much impaired. To overcome this, instruments with revolving transmitters were some time ago put on the market, the purpose being that by giving a half-turn or so to the mouth-piece, which was fixed to the microphone or transmitter case, the carbon might be shaken up and speaking rendered clearer. That this is a necessity is proved by the fact that the Hunnings instruments adopted by the Post Office are so fitted.

Even if one always thought of it, it is somewhat troublesome



GENT'S REVOLVING TELEPHONE TRANSMITTER.

to have to give the mouthpiece a turn before speaking; and to obviate this, Messrs. Gent & Co., Leicester, England, have brought out an instrument in which the transmitter is automatically revolved. The arrangement is shown in the figure, and it will be clear that the microphone case is moved round a little every time the receiver is taken off its hook. In another form, this automatic rotation is performed not by the switch-hook, but by the ringing key.

BALTIMORE WEATHER WARNINGS TO BE GIVEN BY TELEPHONE.

Weather Observer Marbury, of Baltimore, is considering several plans for the increase of the usefulness of the weather service to the people in general. He has been conferring with the officers of the Chesapeake and Potomac Telephone Company relative to an arrangement he desires to make, which will be a a benefit to all the subscribers of the company. Mr. Marbury proposes to make an arrangement with the company whereby all the telephone subscribers will be promptly notified of any decided change in the weather as soon as the observer himself is notified by the chief observer at Washington. By this means the approach of a cold wave or a storm or any decided change in the weather will be made known throughout the city and surroundings wherever a telephone line extends. As soon as the observer is notified by the general office at Washington that a decided change in the weather is coming, the general office of the telephone company will be informed, and the operators who answer calls will notify each subscriber.

LARGE SALE OF BELL TELEPHONE STOCK.

The residue of the last issue of American Bell Telephone stock not taken by shareholders, consisting of 5,849 shares, was sold by auction in Boston on Oct. 30, and went to Edgerly and Crocker, who bought the whole lot at 196 for Blake Brothers & Co. The latter may sell some of it, but it is understood that most of the stock goes into investment hands. Blake Brothers are identified with large interests in the stock.

1. *London Electrical Engineer.*

THE SOUTHERN NEW ENGLAND TELEPHONE COMPANY TO ISSUE NEW STOCK.

The Southern New England Telephone Company will soon issue new stock to be offered to shareholders in the proportion of of one share to ten and increasing the capital stock of the corporation from $1,500,000 to $1,650,000. The company now pays 6 per cent. annual dividends.

WANTS TO MARRY BY TELEPHONE.

Albert Corri in Chicago wants to marry by telephone, or telegraph, a woman who has reached New York on the "Rotterdam," and is held at Castle Garden because she has no money. Mr. Corri is also too poor to come on to New York, but is willing to get spliced with wire as a pledge of his good faith.

A NEW CUBAN CABLE.

The new cable connecting Havana with Santiago de Cuba by way of Casilde, Jucaro, Tunas, Santa Cruz, and Manzanillo, which is now being laid by the Cuba Cable Company, will be completed and in operation by Nov. 10. The company, which has its headquarters in London, is indirectly under the control of the Spanish Government, and the cable will be of great service to that Government in the prosecution of the war in Cuba.

Many of the places which will be brought into communication with Havana by the new cable have been practically cut off from the rest of the world heretofore. Since Feb. 16 the land telegraph lines in the eastern part of Cuba have not been in working order, and, consequently, the commanders near the seaboard have had great difficulty in communicating with the troops in the interior. News from the towns and cities on the coast could be obtained only by means of mail steamers.

THE CABLE ROCK OF TRINIDAD.

Sir John Pender, M. P., presiding at a meeting of the directors of the Brazilian Submarine Telegraph Company, on Oct. 30, said that the position of the company in its dealings with the Brazilian Government was unsatisfactory. Brazil, he said, ought to have treated this pioneer company better, since it had helped to build up Brazilian trade by bringing the country into cable relations with the rest of the world. It was when they had found that Brazil would not deal fairly with them that they had tried to carry on traffic with the Argentine Republic.

They had laid a cable across the Andes with the West Brazilian Company, and to prevent Brazil from interfering with that traffic they had looked out for a fresh station, and had pitched upon the Island of Trinidad, which was not occupied and was an excellent station. Brazil was now trying to make the matter a political question, but the company would not object to Brazil possessing the island if she permitted the telegraph company to use it as a telegraph station.

THE PACIFIC CABLE SCHEME.

A SPECIAL dispatch from London of October 29 says: The Pacific cable scheme, advocated by a number of the British colonies and the Dominion of Canada, was decidedly advanced to-day at a meeting of the representatives here of Canada, Australia, New Zealand, and the South African colonies. The meeting was held at the office of Sir Charles Tupper, the Canadian High Commissioner, and the chief point discussed was the joint attitude of the colonial representatives. The new instructions sent by the colonies to their agents-general show that the colonies are for the most part willing to bear their share of the expense of the cable, and that they are anxious the matter should be actively pushed. Upon the return to town of Joseph Chamberlain, Secretary of State for the colonies, a date will be fixed for a conference at the Colonial Office, when it is expected definite action will be taken. It was said at the meeting that the exclusive concessions of Hawaii to an American cable company, if ratified, would increase the cost of the proposed Pacific cable, as the line would have to be landed at some other point.

REPORTING FROM PIKE'S PEAK.

GENL. ECKERT, president of the Western Union, reported to his office last week from Pike's Peak. The General is making a tour of the western country. He reported that business at all points which he had visited seemed to be reviving, and a more prosperous condition of things generally was promised for the near future.

THE BELL TELEPHONE OUTPUT for the month ending Oct. 20 shows a net of 8,664 instruments as compared with 3,346 last year. The gain since Dec. 20, 1894, is 68,298.

SOCIETY AND CLUB NOTES.

MR. P. B. DELANY ON "HIGH SPEED COMMERCIAL TELEGRAPHY."

A very able and interesting address on the above subject was delivered by Mr. Delany before the New York Electrical Society, at Columbia College, on Oct. 28, the audience being large and appreciative. The lecturer went over the statistics that he has recently made familiar in THE ELECTRICAL ENGINEER showing the inadequacy of existing methods of telegraphy to satisfy public needs or compete with the telephone, and he then advocated his new high speed system of machine telegraphy by means of which he proposes to send mail matter, at mail rates, over the wires. Mr. Delany's apparatus, which was put through its paces, comprises a perforator for preparing the message, all in dots, instead of dots and dashes; a transmitter through which the tape is run, and the electrolytic receiver which reproduces and records the impulses of current from the transmitter. Mr. Delany claimed that by such means he can transmit and receive 2,000 words per minute; he sent some 300 through in a flash. The lecture created a deep impression on its auditors.

HENRY ELECTRICAL CLUB.

THE Henry Electrical Club held its first meeting on Friday, October 4th, at the rooms of the American Institute of the City of New York, 111-115 West 38th Street. Thenceforth lectures are being delivered on every Friday night on the following subjects: 1. Principles of Dynamos. 2. Shunt Dynamo. 3. Series Dynamo. 4. Compound Dynamo. 5. Alternators. 6. Armature. 7. Field. 8. Design. 9. Tests on Iron and Steel. 10. Testing of Dynamos. 11. Running and Handling. 12. Methods of Driving Dynamos. 13. Transformers. 14. Switch Boards. 15. The Line. 16. Subways. 17. Systems of Regulation. 18. Interior Wiring, Conduits, Etc. 19. Safety and Distributing Devices (Cut-Outs, Fuse Blocks, Panel Boards). 20. Circuit Wiring, Sockets, Lamps. 21. Principles of Motors. 22. Shunt Motors. 23. Series Motors. 24. Alternating Motors. 25. Testing of Motors. 26. Troubles in Dynamos and Motors and Their Remedies.

One other night in the week, Tuesday, will be devoted to class work, where the members are allowed to ask questions, and such questions are discussed by an instructor. This part of the club is under the supervision of the University Extension of the State of New York, which is of direct advantage to the members, inasmuch as they are allowed to undergo examinations, in return of which they receive, if their knowledge is sufficient, a regent's diploma in due time.

The executive committee has thought it advisable that the members of the club should be given a chance to study elementary mathematics, and arrangements have accordingly been completed to have 15 lectures on algebra delivered every second Tuesday, in addition to the class work of that night.

For further particulars, people are requested to address Mr. Geo. W. Whitefield, the secretary of the Institute, 111-115 West 38th Street.

THE PEDERSEN ELECTRICAL ENGINEERING LECTURES.

MR. F. M. PEDERSEN, E. E., assistant engineer of the Crocker-Wheeler Electric Co., is to deliver a very useful course of fifty lectures on electricity at the Young Men's Christian Association, East Twenty-third street, on Wednesday and Saturday evenings. To attend this course, a student must have a $6 Educational Ticket and pay a matriculation fee of $1 per term of school year. The Educational Prospectus can be obtained at 52 East 23rd street, New York City.

BROOKLYN ELECTRICAL SOCIETY.

The latest appliances for the measurement of electrical resistances were the subject of an interesting lecture delivered by Mr. Otto T. Louis, of the Queen company, before the Brooklyn Electrical Society on Tuesday evening, Oct. 29, in the Edison Assembly Rooms, Brooklyn. Mr. Louis described at length all the more important resistance testing instruments in their process of manufacture, also a new form of American standard, which is an improvement on the British Association unit. The lecturer also described and exhibited a new bridge capable of measuring resistances as low as that of three-fourths inch bar copper. At the close of the lecture, Mr. Louis made several donations of apparatus to the Society.

PERSONAL.

COL. W. E. SHELDON, for 16 years with the Fitchburg Steam Engine Co., resigned on Oct. 1 and is now with the Providence, R. I., Steam Engine Co., manufacturers of the celebrated Greene engines, whose use in electrical plants has become quite extensive.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED OCT. 29, 1895.

Accumulators:—

Secondary Battery Plate and Method of Preparing it, J. J. Rooney, Brooklyn, N. Y., 549,028. Filed April 1, 1895.

Employs a grid of perforated press board paper with active material filling the perforations and conducting strips in contact with the material in the perforations. See page 445, this issue.

Secondary Battery Grid and Plate and Method of Preparing Grids, J. J. Rooney, Brooklyn, N. Y., 549,079. Filed July 22, 1895.

Claim 5 follows:—A secondary battery grid of paper coated with vulcanised rubber and having perforations to hold the absorptive material.

Alarms and Signals:—

Audible Alarm for Valises, etc., W. F. Murphy, Charleston, S. C., 548,887. Filed Aug. 30, 1895.

Electric Train Signal, M. W. Parrish, Detroit, Mich., 548,984. Filed Dec. 24, 1894.

An electric signal system between the conductor and the engineer of a railway train.

Automatic Circuit-Breaker Alarm, J. H. Devine, Johnstown, Pa., 548,968. Filed Nov. 13, 1894.

Electric Burglar Alarm, M. Anthony, Streator, Ill., 549,045. Filed Feb. 14, 1895.

A burglar alarm applicable to the parting bead of a window casing.

Batteries:—

Dry Battery, J. T. Todd, Tuscola, Ill., 548,780. Filed Feb. 6, 1895.

Consists of a cell in which the central negative carbon electrode is made hollow in order to allow liquid to be poured into the interior of the cell.

Conductors, Conduits and Insulators:—

Junction Box and Mode of Lining Same, W. T. Ruete, New York, 548,660. Filed Feb. 25, 1895.

A junction box lined with a thin layer of paper treated with highly heated hydrocarbon compound.

Insulator Pin, C. W. Stephen, Camden, N. J., 548,669. Filed Feb. 9, 1895.

Distribution:—

Distribution System for Alternating Currents, A. L. Searles, Brooklyn, N. Y., 548,789. Filed April 18, 1895.

Has for its object a local regulation of supply current in accordance with local demand.

Dynamos and Motors:—

Dynamo Electric Machine, N. Whichello, Chicago, Ill., 548,684. Filed July 18, 1895.

Employs a massive field magnet excited by a single coil and a fixed armature arranged in band form and entering an annular air gap in one of the radial faces of the field magnet.

Polyphase Alternating Current Motor, F. S. Hunting, Fort Wayne, Ind., 548,709. Filed March 14, 1893.

The invention comprises an alternating current induction motor, the secondary winding of which is provided with means for coupling its convolutions; the secondary winding being so related to the core that co-operating coils will be in the same phase relation to the core.

Device for Regulating Current Admitted to Electric Motors, F. E. Herdman, Winnetka, Ill., 548,829. Filed Mch. 22, 1895.

Automatically Controlling Electric Motors, F. E. Herdman, Winnetka, Ill., 548,830. Filed June 29, 1895.

Turbine Electric Generator, C. E. Sargent, Chicago, Ill., 548,930. Filed Sept. 19, 1894.

Claim 1 follows: In an electric generator, an armature provided with a series of vanes and suitable ports and supply pipes for delivering a gas at great velocity against the vanes and for receiving the discharge therefrom.

Indirect Control of Motors, G. S. Dunn, New York, 549,061. Filed Aug. 12, 1895.

Employs means for regulating the field independently of the armature.

Lamps and Appurtenances:—

Electric Arc Lamp, M. Wheless, Washington, D. C., 548,682. Filed May 2, 1895.

Relates especially to the feeding mechanism and adjustment devices.

Electric Arc Lamp, M. Wheless, Washington, D. C., 548,683. Filed June 8, 1895.

Electric Arc Lamp, R. & H. Niewerth, Berlin, Germany, 549,074. Filed Apr. 25, 1895.

Electric Arc Lamp, R. & H. Niewerth, Berlin, Germany, 549,075. Filed Apr. 30, 1895.

Electric Arc Lamp, M. Wheless, Washington, D. C., 549,068. Filed March 6, 1895.

An enclosed arc lamp in which the solenoid is mounted upon a tube closed at the top and opening into the globe through a cap.

Measurement:—

Electrical Recording Apparatus, A. C. Crehore, Hanover, N. H., 548,700. Filed Apl. 8, 1895.

The invention consists of a polarizer and an analyzer and a medium acting under the influence of the magnetic field to rotate the plane of polarization and a photographic apparatus for recording the variations in the beam.

Indicator for Electric Currents, A. C. Crehore, Hanover, N. H., 548,701. Filed May 25, 1895.

The invention consists in a method of measuring the vibrations of an electric current by rotating through the action of the current the planes of polarization of the component rays in a beam of polarized light resolved into the colors of the spectrum, and photographing the variations on a rapidly moving sensitized plate.

Electric Meter, R. O. Hood, Danvers, Mass., 548,755. Filed Mch. 9, 1895.

Miscellaneous:—

Telautograph, G. S. Tiffany, Highland Park, Ill., 548,729. Filed Mch. 16, 1894.

Automatic Cut-Off Mechanism, W. M. Williams, Opelika, Ala., 548,733. Filed June 8, 1895.

An electro magnetic cut-off for steam pipes, etc.

Electrode for Applying Electric Currents, E. F. Davis, West Caton, N. Y., 548,777. Filed June 10, 1895.

Electric Brake, F. E. Case, Schenectady, N. Y., 548,952. Filed June 29, 1894.

Provides means for controlling the flow of current in a brake circuit supplied from a motor operated as a generating source by the momentum of the vehicle, consisting of a shunt around the field magnets of the source of current.

Electric Program-Clock, L. H. Watters, Media, Pa., 549,038. Filed Nov. 30, 1891.

Photographic Retoucher, J. N. Choate, Carlisle, Pa., 549,058. Filed Nov. 7, 1894.

Railways and Appliances:—

Electric Traction, E. Chabeault, Marseilles, France, 548,627. Filed Aug. 17, 1894.

Employs a sectional feed wire with automatic lifting devices bringing it in contact when needed with a contact plate between the rails, and a pneumatic arrangement for preventing the accumulation of water in the conduit.

Trolley Wheel, F. J. Feldt, Peoria, Ill., 548,704. Filed April 20, 1895.

Relates especially to the lubrication of the trolley wheel.

Underground Electric Railway, H. B. Nichols and F. H. Lincoln, Philadelphia, Pa., 548,798. Filed Mch. 11, 1895.

A conduit electric railway in which the main conductor is suspended from cross guys attached to the structure and thoroughly insulated by means of strain insulators or the like.

Closed Conduit Electric Railway, M. F. Flynn, Stamford, Conn., 548,976. Filed Nov. 27, 1894.

Employs a trolley carried by the car and running along a contact rail above the conduit, switch devices at intervals and a shifting device carried by the car to return the switches to a neutral position.

Electric Motor Car Trolley, J. M. Kennedy, Hollidaysburg, Pa., 548,997. Filed May 31, 1895.

Employs an arm connected with the trolley pole and extending through the roof of the car by means of which the pole may be drawn down or shifted in any direction from within.

Trolley for Electric Railways, J. Hess, Scranton, Pa., 549,091. Filed May 13, 1895.

Employs two small wheels journaled upon arms extending above the trolley wire for the purpose of preventing the trolley from leaving the wire, the wheels being adapted to separate in order to allow the trolley to pass the hangers.

Switches, Cut-Outs, etc.:—

Electric Switch, J. C. Cassidy, East Orange, N. J., 548,744. Filed July 19, 1895.

Electric Switch, H. Ross, Providence, R. I., 548,819. Filed July 17, 1895.

Rheostat Element, H. P. Davis, Pittsburgh, Pa., 548,867. Filed Feb. 28, 1894.

A resistance column composed of a support upon which are strung a quantity of discs, the alternate ones provided with knobs forming restricted contact.

Automatic Time Cut-Out, F. B. Badt, Chicago, Ill., 548,904. Filed Sept. 24, 1894.

Consists of two mercury tubes containing conductors, the coil about one tube and a conductor supported at one end on a float in one tube its other end in proximity to the mercury in the other tube.

Safety and Limit Switch for Electric Motors, G. F. Card, Mansfield, Ohio, 548,949. Filed Aug. 21, 1895.

Telegraphs:—

Telegraph Instrument, O. A. Dickinson, Arverne, N. Y., 548,969. Filed July 13, 1895.

A telegraph key of special construction.

Telegraph Pole, A. A. Blow, Denver, Colo., 549,053. Filed Jan. 26, 1895.

A hollow metallic telegraph pole with means for insulating the various parts to avoid leakage of current.

Telephones and Apparatus:—

Microphone, L. M. Ericsson, Stockholm, Sweden, 548,748. Filed July 6, 1895.

Employs a supplemental protecting diaphragm between the vibrating diaphragm and the mouth-piece, consisting of silk impregnated with lacquer.

Telephone Switch, J. E. Thomas, Cleveland, Ohio, 548,897. Filed April 17, 1895.

LEGAL NOTES.

SIEMENS-HALSKE SUIT ON ARC LIGHTS.

A bill for an accounting and for an injunction restraining the sale of the chain feed arc electric lamp has been filed in the United States Circuit Court, Chicago, against the General Incandescent Lamp Company, of New York, and E. Baggot, of Chicago, by the Siemens & Halske Company. The suit will be the second begun within a week by the same parties against the defendants named.

WADDELL-ENTZ SALE NOT CONFIRMED.

Judge Elmer of the Bridgeport superior court has refused to confirm the sale of the Waddell-Entz Electrical company's stock for $15,000, offered by a New York syndicate. Judge Perry, for Proctor & Gamble, of Cincinnati, protested and the court said it would continue the matter for another week.

THE ADAMS RAILWAY LITIGATION.

The suit in which the Adams Electric Co., of St. Louis, was worsted before Judge Hallett has come up in review before the Circuit Court of Appeals at St. Paul. It will be remembered that Dr. Wellington Adams made claim of infringement by Sprague, but the lower court rejected his case in toto.

NEW MOVE IN THE BERLINER LITIGATION—A MOTION TO DISMISS IN THE U. S. SUPREME COURT.

A MOTION to dismiss the appeal of the United States from the judgment of the Court of Appeals of the First Circuit in the Berliner telephone patent case was submitted in the Supreme Court of the United States on Oct. 28 by the Bell Telephone Company, assignee of the patents involved. The ground upon which the motion is based is that the proceeding being one arising under the patent laws of the United States, the judgment of the Court of Appeals sustaining the patent is final.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

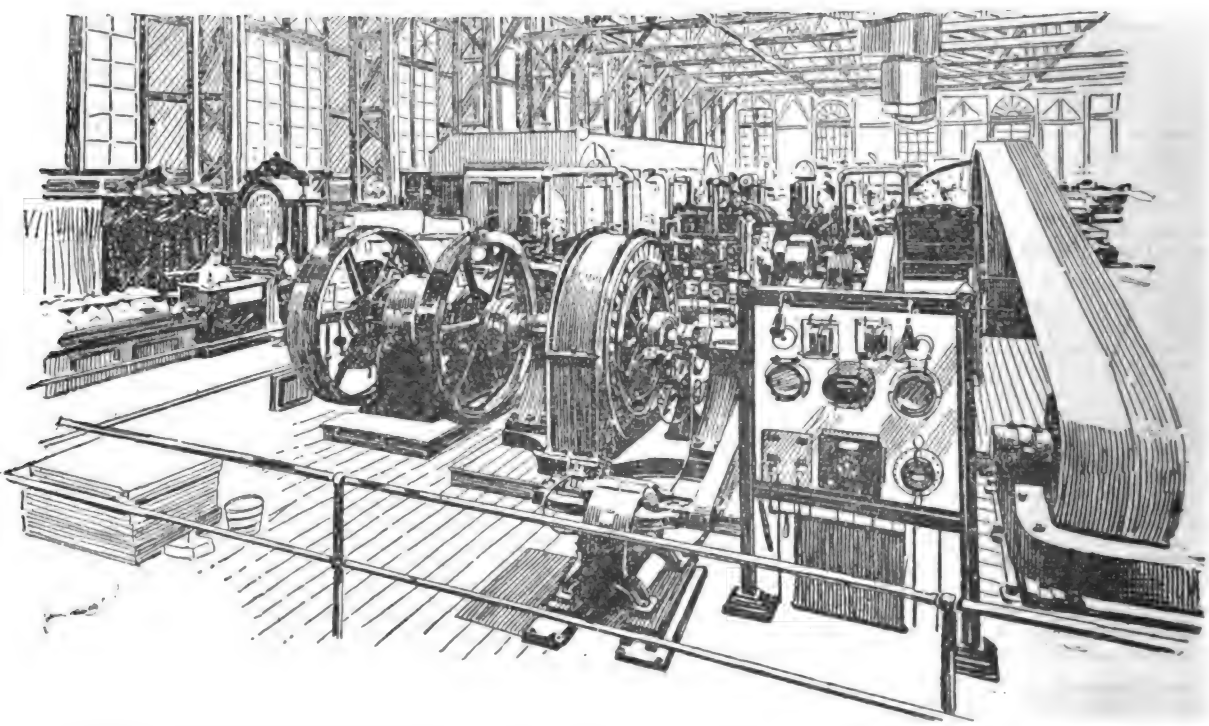
ELECTRICITY AT ATLANTA.—THE EXHIBIT OF THE FORT WAYNE ELECTRIC CORPORATION.

One of the most complete as well as the most interesting of the electrical exhibits at the Atlanta Exposition is that of the Fort Wayne Electric Corporation. The corporation really has two exhibits, the one in the Machinery Hall, where the motive power is generated, and the other in the Electrical Building, which, upon the touch of a button, gains life and action from its connection with Machinery Hall. The exhibit in Machinery Hall runs all of the lights in the buildings, from the great Art Gallery around to the forestry display, and along the west side of the grounds to Machinery Hall, as well as a great many of the arc lights around the waters of Clara Meer and the grounds upon which the Exposition stands. This display consists of one 160 K. W. alternator, which is directly connected by means of a flexible insulated coupling to a compound Harrisburg Ideal engine, and a 125-light slow-speed arc machine.

The directly connected alternator occupies a prominent place in the corner of the block, which is devoted to that class of machines. Rising, as it does, seven or eight feet from the floor, this alternator presents an imposing and massive appearance, as it looks down upon its smaller neighbors in the immediate vicinity. The armature revolves at 240 revolutions. A neat marble switchboard stands at one side, equipped with all the necessary instruments.

The 125 arc-light machine is found situated in another part of the building devoted to arc-lighting machinery, and strikes the visitor as a marvel of perfect workmanship and graceful design. This machine is so constructed that it will deliver constant currents to the working arc lamps of a voltage from zero to 6,250 volts. The machine adapts itself to any of those enormous changes of load without any assistance from the attendant. So perfectly does this machine perform this function that although it is running something over 100 lights at different places on the grounds, there is absolutely no spark at the commutator, and it is difficult to realize that it is generating sufficient electricity to light a good sized village. While this type of machine is not a stranger in Atlanta—as the Georgia Electric Light Company has two of them operating every night in its station—yet it is exhibited here for the first time at any exposition.

It is over in the Electrical Building, however, that the excellence of the machinery of the Fort Wayne Corporation is exhibited in the display of electrical apparatus. The exhibit occupies a space 40 by 24, immediately north of the main entrance, and it consists of a fine assortment of standard machines, embracing the following apparatus: One 80-light arc machine, with a complete bank of lamps of the different varieties manufactured; the switchboard for ten arc machines, and ten circuits, together with the necessary instruments to operate the same. One 160 K. W. multipolar. One 37½ K. W. alternator, with switchboards and instruments for the same. One 160 H. P. 220-volt motor, together with an assortment of smaller motors. A complete assortment of transformers running from six to 750 lights. A complete assortment of meters and a bank of lamps to load the same. The corporation also exhibits a marine projector, and an assortment of synchronous self-starting alternating current motors.



LIGHTING PLANT, EXHIBIT OF THE FORT WAYNE ELECTRIC CORPORATION AT THE ATLANTA EXPOSITION.

PLANTS RECENTLY INSTALLED BY MR. AUGUSTUS NOLL.

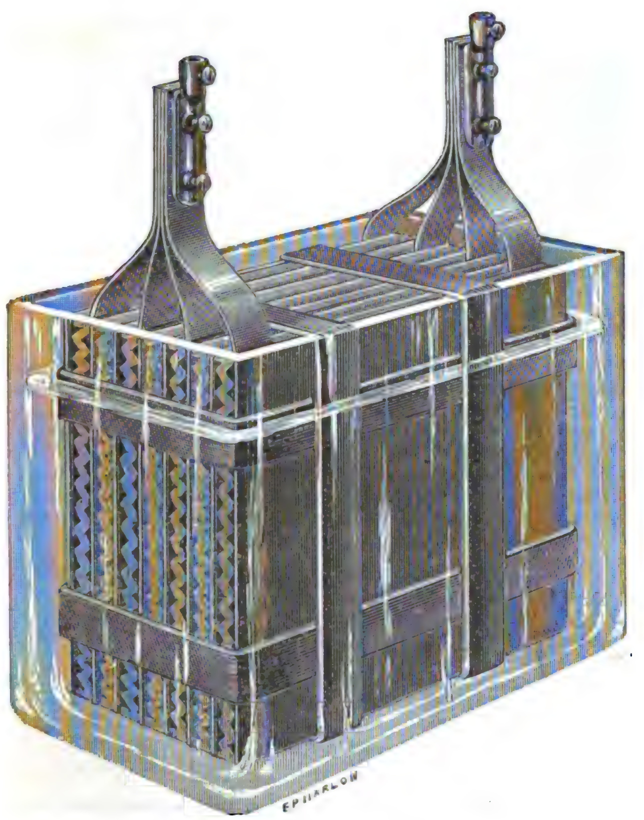
The subjoined is a partial list of the plants contracts for which have recently been closed by Mr. Augustus Noll, contract-tracting electrical engineer, 8 East Seventeenth street, New York city. It is a fair indication of the renewing activity in the electrical field:—Residence, Mrs. Rhinelander Waldo, N. Y., wiring for 1700 lights, electric bells, burglar alarm, speaking tubes and annunciators; residence, Mrs. Rhinelander Waldo, owner, N. Y., wiring for 600 lights, speaking tubes and annunciators; residence, Mr. J. T Williams, Stamford, Conn, wiring for 600 lights, bells, speaking tubes, burglar alarm, annunciators and telephones; residence, Mr. Peter Marie, N. Y., wiring for 300 lights, electric bells and annunciators; residence and barn of the Hon. Alfred Hand, Scranton, Pa., wiring and fixtures for 400 lights; Hotel Warwick, N. Y., wiring for 350 lights; 733 and 735 Broadway, wiring for 1,000 lights; 707 and 709 Broadway, wiring for 1,350 lights; 891 Fifth Avenue, wiring for 150 lights; 1421 and 1423 Third Ave., wiring for 400 lights; 59 Bleecker street, wiring for 200 lights, and seven 10 horse-power motors.

Stable of Alexander Moore, N, Y., wiring for 250 lights; Commonwealth Building, Scranton, Pa., wiring for 300 lights; Tribune Building, Scranton, Pa., wiring for 450 lights; Bartlett Lithographing Co., N. Y., wiring for 100 lights; apartment House, 126th St. and St. Nicholas Ave., wiring for 700 lights, speaking tubes, bells and annunciators; apartment House, 88th St. and W. Boulevard, wiring for 850 lights; apartment House, 81st St. and Park Ave., wiring for 700 lights; T. P. Galligan & Son, isolated plant for incandescent and arc lights; apartment House, 94th St. and West End Ave., wiring for 875 lights, engines, dynamos and switchboard; apartment house, 113th St. and Seventh Ave., wiring for 800 lights, engines, dynamos and switchboard; apartment house, 69th St. and W. Boulevard, wiring for 850 lights, engines, dynamos and switchboard; apartment house, 68th St. and Central Park West, wiring for 800 lights, engines, dynamos and switchboard; office building, Broadway and Broome St., wiring for 1,650 lights and electric elevator, dynamos, engines and switchboard.

THE HATCH STORAGE BATTERY.

The Hatch Storage Battery Co., of 421 Chestnut street, Philadelphia, gave an exhibition of their product on Oct. 31. The Hatch storage battery was invented by George E. Hatch, of Quincy, Mass., in 1890, and is covered by U. S. Patents. Since the invention, continuous experiments have been made with the battery by Mr. Hatch both in the laboratory and in practical work.

Instead of the lead grids, Mr. Hatch uses light porous earthenware and places the active material upon them instead of in them, and by closing them together and binding them in place with light wooden boards and flexible rubber bands, he secures strength, lightness and elasticity to allow for expansion and contraction. At the same time he holds the active material in place and together, thus preventing loss of element and of current.



ONE FORM OF HATCH STORAGE BATTERY.

The material used is the same as that employed in lead storage batteries, i. e, peroxide of lead, and 20 per cent. solution of sulphuric acid. The current is conveyed from the grid or lead plate by the grid or plate itself through a prong or fork extending from the top. Mr. Hatch derives his current by means of thin lead sheets inserted between his plates filled with the active material or peroxide of lead.

The officers of the Hatch Co. are Jacob E. Ridgeway, president; J. Uhle Bethell, secretary and treasurer; and George E. Hatch, general manager. Mr. Ridgeway is president of the Quaker City National Bank.

IMMENSE NEW TURBINE PLANT FOR NIAGARA.

THE Niagara Falls Hydraulic Power and Mfg. Co. have recently contracted with James Leffel & Co., of Springfield, Ohio, for four of their Improved Double Discharge Horizontal Shaft Water Wheels, to be of eight thousand horse power capacity, under a maximum head pressure of 218 feet, which is far the highest head, under which turbines of large capacity have ever been applied in this country or elsewhere. These wheels will drive eight electrical generators, which will be connected direct to the horizontal turbine shafts, without gears or belting; the wheels and generators all running in vertical planes. This is the second large order for turbines built by James Leffel & Co. for Niagara Falls; there being already several of this make of wheel, each of 1,200 horse power, in daily operation in the Cliff Paper Co. Mills, located at the cliffs, near the tunnel. This water wheel company are also building four of their Cascade wheels for one company, to be operated under seven hundred and thirty feet head; part of the power to be electrically transmitted, by connecting the wheel shaft directly to the generators. The Cascade wheel is, however, essentially and entirely different in construction and operation from the turbine, being in principle an impulse and reaction wheel. This Cascade wheel plant will have an aggregate capacity of six hundred horse power.

WHEELER HEADLIGHTS AND REFLECTORS.

The Wheeler Reflector Co. of Boston, U. S. A.—18 to 24 Washington street, have gradually accumulated a splendid line of reflectors for all kinds of electric lighting, and their productions are not to be surpassed. These reflectors are made not only for ordinary arc and incandescent work, but for special uses, and particular mention may be made of their apparatus for inverted arcs, with which excellent results in the diffusion of light are obtained. A pamphlet is devoted to the reflectors, and another to the headlights, both electric and oil. Sockets and connections are included in the details given. Prices are quoted on all the separate appliances, and the catalogues are good things for prompt reference in all classes of lighting and railway work.

FORT WAYNE ELECTRIC CORPORATION CONTRACTS.

Mr. E. T. Pardee, who is in charge of the Omaha office of the Fort Wayne Electric Corporation, reports that the apparatus of that company is daily increasing in favor in the West. Among the contracts which he has recently secured for it may be mentioned: The Laporte City, Ia., Electric Light & Water Company, for a 1,000-light Wood alternator for its new plant; F. F. Vater & Co., Minneapolis, for 100 H. P. tandem compound Ball engine and two Freeman boilers; the city of Vinton, Ia., for an 1,800-light "Wood" alternator, for its new city electric light plant; the Mason City, Ia, Electric Company for a 1,500-light Wood alternator and an 80-light Wood arc dynamo; the Vermillion Milling Co., Vermillion, So. Dakota, for a 750-light Wood alternator. All this apparatus has been sold through the Omaha office of the Fort Wayne Electric Corporation.

THE E. G. BERNARD CO.

The E. G. Bernard Company, of Troy, have fitted up a large machine shop, comprising two floors of twenty-six thousand square feet. They have introduced new and improved machinery, suitable for doing all electrical work connected with their business, and having facilities for every character of mechanical work, from the finest to the heaviest. The E. G. Bernard Co.'s electrical business has grown to large proportions. They have put in more electric plants in some lines than any other contractors. They furnish plans and specifications for boilers, engines, steam heating and electric lighting for factories, large stores and dwellings, and manufacture much of the machinery required.

NEW ERA ENGINES FOR GAS AND GASOLINE.

IN the catalogue of the New Era Iron Works Co., Dayton, Ohio, exceptional economy in fuel and development of power is claimed for the New Era engines. The standard engine of the company is built on the plan of a lateral shaft to run the governor, with cams that operate direct on the valves. The absence of rods, elbows, arms, eccentrics, cranks, etc., is emphasized, as these parts frequently give rise to trouble when adjustment from wear and tear is necessary, and where an expert is not available great difficulty is often experienced in bringing them into proper adjustment. The valves are set so that they can be taken out, or ground in, by merely removing the nut that holds them in, without disturbing any other part.

This engine requires 15 to 20 cubic feet per hour per horse power, according to quality and pressure; of natural gas somewhat less, and of gasoline one-tenth of a gallon per horse power per hour. In many instances the consumption of fuel comes far below these figures. All the New Era engines are fully guaranteed for twelve months.

LOMBARD WATER WHEEL GOVERNOR.

A very interesting and instructive circular has been issued by the Lombard Water Wheel Governor Co., of 61 Hampshire street, Boston, relative to the work done with their appliance in the finer and closer regulation of wheels, particularly such wheels as are used to drive electrical generators, where the closest approximation to absolute steadiness of running is required. The record and records of the Lombard governor are hard to beat.

SALE OF THE PUMPELLY-SORLEY STORAGE PROPERTY.

THE Electric Storage Battery Co., of Philadelphia, has acquired all the patents and property of every character and description of the Pumpelly-Sorley Co., including their factory in Chicago, where it will continue to make small batteries, chiefly for local use.

LARGE SALES OF WATERTOWN ENGINES.

AMONG recent sales of Watertown Engines are the following: Three high speed engines direct connected to General Electric dynamos for the Barr Dry Goods Co., of St. Louis; one 150 H. P. high speed, single cylinder engine for the St. Louis Exposition; one 50 H P. for the W. L. Douglas Shoe Co., of Brockton, Mass; one H. P. for the Chatham, N. Y., Electric Co.; one 100 H. P. for the Bainbridge, N. Y., Electric Co.; one 100 H. P. slow speed Automatic for Blood Knitting Co., Amsterdam; one 40 H. P. Puget Sound Flouring Mill Co., Tacoma, Wash.; one 100 H. P. La Harpe Electric Co., La Harpe, Ill.; two 80 H. P. Fulton, Mo., Electric Light Co.; one 60 H. P. direct connected to LaRoche dynamo for L. Z. Bach apartment house, New York; one 60 H. P. for Schnorer's apartment house, New York.

THE OHIO STORAGE BATTERY CO.

It is a fact of considerable local interest, says one of the Cleveland newspapers, that among the last important acts of Mr. F. L. Pope's life was the preparation of an elaborate opinion to the effect that the patents covering the Ford-Washburn storage battery do not infringe in the slightest degree any other storage battery patents. Mr. Pope's papers was dated the 5th Oct., and was accompanied by an autograph personal letter. The Ford-Washburn battery is now manufactured by the Ohio Storage Battery Company, of that city, sole licensee of the Ford-Washburn Storelectro Company during the life of the patents in question. The Ohio Storage Battery Company, behind which are some of the strongest capitalists of Cleveland, promises to become one of the conspicuous industries of the city.

WESTINGHOUSE FACTORY BUSY.

THINGS appear to be booming out in Pittsburg. A dispatch from that city says that the Westinghouse Electric Company is doing a large and increasing business at its new works, which are now in a completed condition. There were shipped from the works during the month of September an aggregate of nearly 25,000 horse power of electric generators and motors, varying from 1,500 horse power down, a very large percentage of the alternating generators being of the multiphase type for the operation of Tesla motors, the use of which is being very rapidly extended in all directions.

THE "IDEAL" HIGH ART ENGINE SOUVENIRS.

A. L. IDE & SON, of Springfield, Ill., have just issued a very tasteful memento of their "Ideal" engines in the shape of a set of large size glazed cards, on one side of which are pictures of the engines and, on the other side, pictures of archaic men and women in odd guises and various colors. These cards are interspersed with others on which are a number of dots or marks, heart-shaped and otherwise, red or black, from one up to ten; and with which, it is said, innocent games, provocative of mirth, may be played by the skillful and rich. The novelty of these cards is such as to ensure them a welcome in all intellectual circles, and we are glad to note that with the object of promoting the public happiness and welfare, the firm will send a choice assortment, in a neat paper case, to any address for ten cents.

ATLANTA EXCURSIONS.

Baltimore and Philadelphia people who intend to visit Atlanta will find a very pleasant route by the Bay Line steamers giving an exceedingly pleasant night's run to Norfolk and Portsmouth where, if desired, a day can be spent pleasantly at Fortress Monroe and that vicinity, whence a fast night train takes them to Atlanta via the Seaboard Air Line. To those who have never visited the historical scene of the battle between the "Monitor" and the "Merrimac," the Bay Line route is one of great interest. "This is the most pleasant season of the year for a trip through the Southern country. The cotton fields along the Seaboard Air Line and the Southern road look like beautiful beds of white flowers. The phosphorescent display in the waters of the Chesapeake Bay on a moonlight night exceeds anything of the kind I have ever witnessed before, either on the Atlantic or Pacific oceans or Southern waters," so says a well-known writer and traveler.

THE OLD "BAY LINE."

Commencing November 1st, the management of the Bay Line steamers will inaugurate a change in serving their meals, making bills of fare for supper on the European plan instead of "Table d'Hote" as formerly.

Several months ago this change was made in serving breakfast, and has worked so satisfactorily to the patrons of the line that it has been decided upon for all meals. The service will be increased, and no expense will be spared to improve, if possible, the justly-earned reputation of the Old Bay Line's cuisine.

WILMOT & HOBBS.

The Berlin Iron Bridge Company have lately completed for Wilmot & Hobbs of Bridgeport, Conn., a new rolling mill to take the place of the one lately destroyed by fire. The main mill is 126 feet wide and 200 feet long with engine and boiler room attached in a separate wing, 54 feet wide by 90 feet long. The construction is entirely fire proof, no wood being used about the building; so that the risk from fire is absolutely eliminated. The roof covering is The Berlin Iron Bridge Company's patent anti-condensation corrugated iron.

WORK OF THE SYRACUSE STORAGE BATTERY.

THE SYRACUSE STORAGE BATTERY COMPANY, 38 and 39 Herald Building, Syracuse, N. Y., are in the market with their storage battery for street cars, electric launches, light and power. The company have received a large number of testimonials, attesting the superior efficiency and economy of their battery. One firm which runs about 300 lights in its show windows until 10 o'clock, 50 lights from 10 until 5 in the morning, and 100 lights in the basement from 7 to 12 in the morning, states that on comparing the fuel used and the quantity of light produced from the battery with the number of lamps formerly run from other sources, it finds a saving in cost of about $8 a day.

THE POPULARITY OF THE PENBERTHY INJECTOR.

The Penberthy Injector Co., of Detroit, Mich, write us that in visiting the State Fair of Mo., recently held at St. Louis, they found nineteen manufacturers of traction and farm engines with forty engines on the grounds. In looking over these engines they found on thirty-three engines out of the forty the "Penberthy" Injector, the other seven having five different makes. They also state that two manufacturers out of these representing the seven engines agreed to use the "Penberthy" Injector in 1896.

THE MOYES "COMBINE" BOILER.

Mr. L. M. Moyes, the patentee and manufacturer of the "Combine Water Tube Boilers," informs us that he has leased the factory premises 1434-36 Randolph St., Philadelphia, Pa., where the manufacturing and assembling of his boiler will be carried on, and where the general offices will be maintained. He is at present arranging for the incorporating of his business with a view to the development of the manufacturing department. The "Combine Boiler" is in successful operation, and a series of tests have shown gratifying results.

Mr. Moyes is at present erecting boiler plants at various points, and mentions 200 H. P. for Thos. Kelley, Esq., Philadelphia; 100 H. P. for St. Ann's Catholic Schools, Philadelphia; 125 H. P. for the Marietta Electric Light Co., Marietta, Pa.; 130 H. P. for the Washington Agricultural College, Pullman, Washington.

He is about to issue the second edition of his catalogue on "Steam Boilers," which will be sent on application and will contain some interesting reading for steam users.

PHILADELPHIA NOTES.

MR. CHARLES WIRT has removed his office to 1026 Filbert St., Philadelphia, for the sake of a more central location. Mr. Wirt reports that his dynamo brush has been greatly improved as the result of a series of careful tests extending over several months and that it is a sure specific for the "Chewing" habit.

WESTERN NOTES.

THE AMERICAN CIRCULAR LOOM CO., of Boston, have opened an office at 1118 Marquette Building, Chicago, with Messrs. H. H. Brooks and A. D. Chandler, both late of Boston, in charge. Mr. Brooks is too well-known to the electrical trade to need any introduction, as he is one of the most popular travelling men on the road, and is known from Maine to California. Mr. Chandler is not new either to the electrical trade, as he has for years been identified with rubber insulating specialties. These two gentlemen should make flexible conduit a popular brand of goods in the West, if their past record counts for anything.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

Vol. XX. NOVEMBER 13, 1895. No. 393.

THE REACTANCE SYSTEM OF ARC LIGHTING.

BY

William Smith Horry

I.

IT cannot be denied that there is some room for improvement in arc lighting. The numerous and comparatively small dynamos, each supplying its own line is quite out of place in a large arc light plant, and these besides being theoretically inefficient, give more trouble and take up more room than would one or two large generators each capable of supplying a whole city in a business-like way. Our other electrical industries have all been greatly improved by the systematic use of large and efficient generating units at the station; the series arc lighting system alone has been left unimproved in this respect, and this industry may therefore be looked upon as being still in a state of transition.

It would be difficult, in the present state of the art, to design an arc light station capable of the lighting of a large city, in any way comparable for economy to, say, an incandescent lighting or electric railway plant; for the reason that our manufacturers have not yet given us a comprehensive system of arc lighting. What we have now is good as far as it goes; our half acre of dynamos, &c., is all very well, but surely something better is coming.

It must be admitted that the alternating arc lamp has done much to settle many problems connected with the supply of commercial arc lights; its introduction has been rapid and satisfactory, and it bids fair to become more used in the future as its economy becomes more appreciated, but for street lighting with transformers there are still some hindrances to its use, and at present the series system is the only one that need be considered for this class of work.

II.

A method of working arc lamps in series from the primary circuit of alternators without using a transformer, resistances, fuses, &c., to each lamp, and which is quite comprehensive enough for modern times, since a whole city can by this method be lighted from one machine, may be deemed of sufficient interest to warrant this description. The generator employed is the ordinary alternator that we are so familiar with in transformer lighting, and the lamp is also the ordinary constant potential alternating arc lamp; and neither is changed in any way, so that different types of lamps, as of dynamos, are unnecessary. One lamp, and that of the most simple construction possible, is substituted for all purposes.

The type of lamp alluded to has already been brought to a high state of perfection and it is, moreover, the most simple and elementary lamp that can be conceived. It has but one solenoid which is in series with the arc, no shunt spool, no cut-out, and is very reliable in consequence of having so few parts. These can now be procured in such sizes as to run for as many as sixteen hours on this system without new carbons, and all-night lighting with this lamp becomes a fact.

If a choke coil, properly designed, be placed across the terminals of such lamps as these, arranged in series, each lamp will be found to regulate perfectly if the voltage at the end of the series be kept constant. The lamps if of 1,200 C. P. will be found to take about 30 volts each. The choke coil need only be a small one and need weigh but a few ounces. It consists of a little core of highly laminated iron wound with wire in such a manner that the passage of even a small current will magnetize the iron very highly. The arrangement is shown in Fig. 1.

For practical work, however, thick wire must be employed, so that when the carbons are all burned away, the winding will take the whole lamp current continuously without injury to itself. Such a coil fitted to a lamp of 1,200 C. P. will weigh about 3 pounds.

III.

Upon this principle the "Reactance System" of arc lighting has been founded and so named because the reactance of a secondary or derived circuit causes the regulation of the lamp which is installed in series with others in the primary line.

The precise mode of operation is radically different from

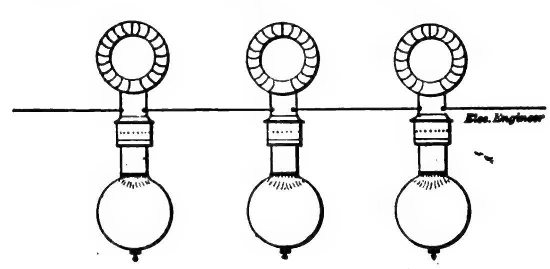


FIG. 1.

any other system. We have a line of many arc lamps in series so that there is to all intents and purposes a constant current passing. Each lamp has a choking coil across its terminals, in shunt with the arc, so that there are two paths for the current, one between the carbons and the other round the impedance coil. With only a few volts difference of potential at the terminals, the current will be all choked out of the coil and all will pass through the arc, it lighting up the lamp the instant the current is turned on. As the carbons burn away the voltage at the lamp terminals will rise and the little coil will begin to leak. The impeding or choking power of an induction coil breaks down as the iron composing its core approaches to magnetic saturation. The result is that the arc is robbed of some of the line current and therefore the lamp solenoid releases its hold on the carbon and causes the lamp to feed. It is found in practice that this device is very thorough. It takes care of the lamp whatever happens—makes it start up at once, keeps the voltage on the arc constant, and the lamp carbons may be open circuited or short circuited without any damage accruing to either the lamp or the line.

IV.

These are new effects in series arc lighting. There was never before such a controlling device, which containing absolutely no mechanism, yet at the right time performs the functions of a starting box, transformer, shunt solenoid, automatic cut-out, and line compensator, and which is possessed of all the qualities necessary to perform each of these duties at the right moment and with unfailing certainty.

To give an idea of the current that passes through an arc lamp when this regulating coil is employed in shunt with it, a table is given below and a diagram Fig. 2 illustrates it graphically.

Amperes Actually Passing Through the Arc.	Volts at Terminals of Lamp.	Observations.
12	0	Carbons touching.
11.2	20	
10.8	25	
10	28	Lamp working properly.
9.4	30	
9	32	
0	36	Carbons separated.

These measurements were taken on a line of 35 lamps arranged in series as in Fig. 1, working at 133 ~ from the

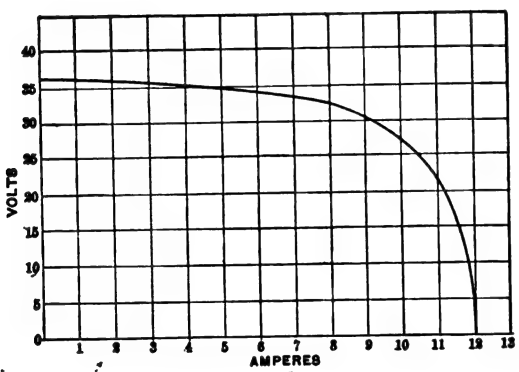


Fig. 2.

primary circuit of a 1,000 volt alternator. The line current in this instance was 12 amperes. It may be remarked that in this case it was necessary to employ a 12 ampere line, as by this means the lamps started up very perfectly, and never failed to burn.

The line adopted in the "Reactance" system, however, is generally 10 amperes and a diagram of the circuits is shown in Fig. 3. In this way a 2,000 volt alternator will run 60 lamps in series each of 1,200 c. p., though in practice, over 8 miles of No. 8 wire, it was found that only about 52 could be run in one series.

The system is automatic over a very wide range. Thus if in a line of 30 arc lamps, five are extinguished in consequence of the carbons having all burned away, the remainder will run on just the same and the ampere meter at the station will not be sensibly affected. This automatic regulation is a very good feature of the system and it amounts in practice to 85 per cent. of the lamps for which the line is adjusted.

V.

The efficiency of the device may be dismissed with a very few words. The amperes that flow through the coil are almost entirely wattless and the whole device is exceedingly efficient. A wattmeter measurement shows the coil to consume about 7 watts and small though this may appear, the measurement has been taken again and again, with the most perfect instruments, with the arc lamp working, and its correctness is beyond question. This applies only to the coil employed with a 1200 c. p. arc lamp; with a full 2000 c. p. arc lamp the loss is about 40 watts because in the case measured the arc regulating coil had to act as transformer as well. The iron in the core of course gets hot and for this reason only very little iron is employed—highly saturated.

The switchboard employed with the reactance system is shown in Fig. 6. It consists of an amperemeter and a

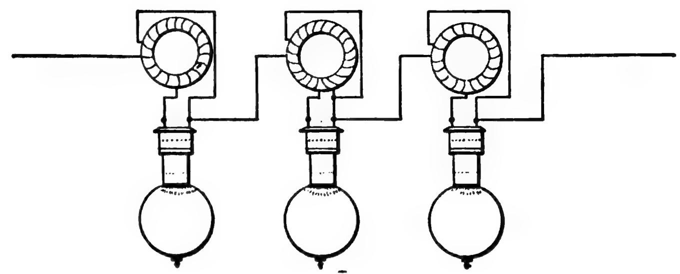


Fig. 6.

pilot lamp—10 amperes, a double pole switch, a fuse block, and a series of contacts for throwing more or less impedance into the line. Lamps of 1200 c. p. are installed as in Figs. 4 or 5, but larger arcs are generally fitted as in Fig. 4. It may be pointed out that lamps of widely different power can be connected in the same line and that though the voltage on a 1200 c. p. lamp is about 30, the larger arcs work better with less, say 24, and that only on this reactance system is it practical to give each lamp the voltage best suited to its needs at all times.

But the most important item of all, more important even than high efficiency—is certainty of operation. In this respect the "Reactance" system leaves nothing to be desired. The coils cannot burn out, as they will take the whole lamp current without injury; lightning cannot hurt them. There are no fuses to blow or to attend to. Altogether the system is as hardy as it is possible for it to be. It is also possible by this system to use a carbon of great length and to regulate it so that the length of the arc is invariable, whether these carbons be just lighted or nearly all burned away; and the arc regulators being so small the period makes little difference. A little larger core is all the change necessary for a regulator to work with 60 ~ instead of 133 ~.

It is obvious that any number of lamps can in this way

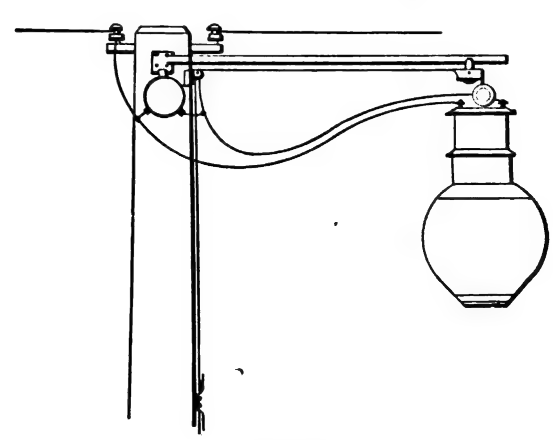


Fig. 4.

be run from one alternator. Step-up transformers can be employed to run 100 or more arc lamps on one line or with two lines double that number. For indoors one large building is lighted with 10 arc lamps supplied as in Fig. 5, from a transformer secondary circuit of 300 volts.

This greatly simplifies the wiring. The system works equally well on a constant alternating current dynamo or on a constant potential machine, and the lamps can all be worked on the secondary C. P. circuit if necessary in the ordinary way.

It is considered a great gain to dispense with the cost

FIG. 5.

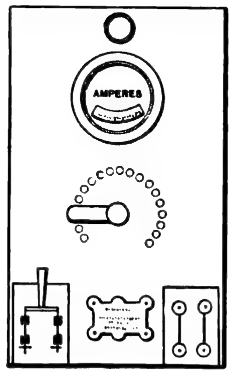


FIG. 6.

of transformers for street lighting and it is hoped that when the extreme economy of the "Reactance" system is appreciated it will be found to be an improvement on existing practice and a step forward in the right direction.

THE BIRKETT AND McELROY ELECTRIC FIRE ENGINE.

An electric fire engine, practicable not alone where special arrangements have been provided for its use, but wherever there exists any system of electrical distribution, has been devised by Messrs. John Birkett and William McElroy, of Brooklyn, and is shown in the accompanying illustrations. The engraving, Fig. 1, exhibits the appar-

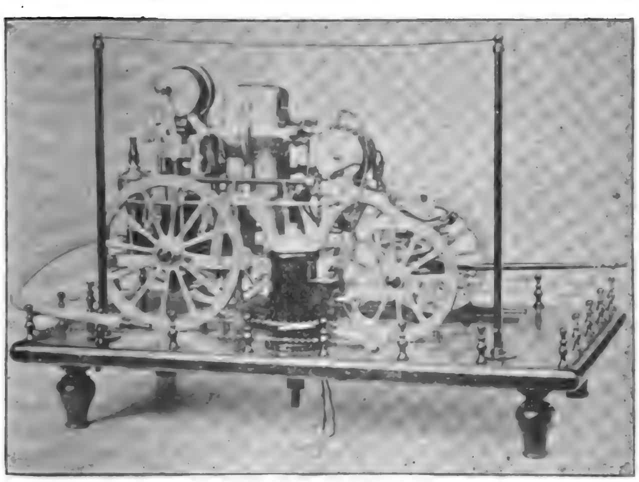


FIG. 1.—BIRKETT & MCELROY ELECTRIC FIRE ENGINE.

atus complete as it appears ready for use; while the diagram, Fig. 2, shows its construction in detail.

The motor is supported at the rear of the engine frame. A worm gear at the end of the armature shaft, operates the piston of the pump which is bolted to the lower side of the engine frame beneath the motor. The hose drum is supported between and above the rear wheels of the engine; and on the outer end of the shaft which supports it is mounted another drum upon which is wound a length of cable. By means of this, contact is made with the terminals of the electric supply system, when such a system is especially provided. Such an arrangement is shown in Fig. 2, where the terminals are brought to the top of the hydrant, and no ground connection is necessary. Fig. 2 also shows by a dotted line, how a ground

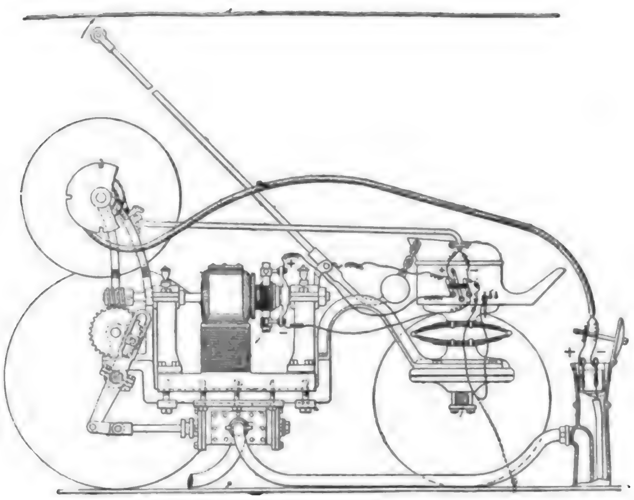


FIG. 2.

may be made when required. In this latter case the trolley takes current from the overhead conductor and a metal pin is driven in beside the track rail. A switch is provided for cutting in or out the motor circuit as desired.

The former of the two methods of connection already mentioned—that in which the conducting wires are led into the hydrant—is intended for an ordinary incandescent or multiple system in which lamps or other devices are arranged in multiple arc. The second arrangement is, of

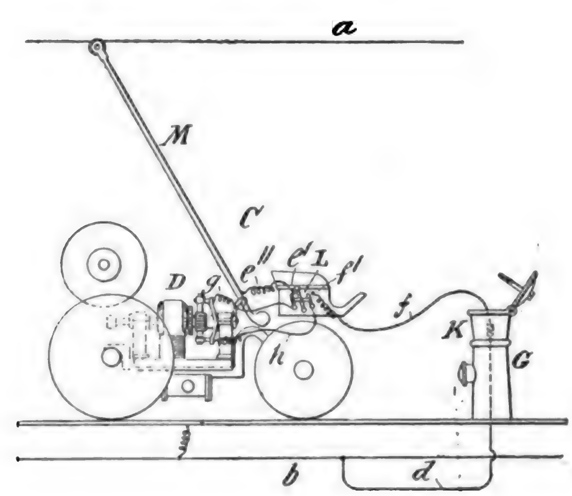


FIG. 3.

course, adapted to the regular trolley railway circuit. Fig. 3 shows still another plan for utilizing the trolley circuit, in which the return is made by a special connection leading from the railway ground wire to an adjacent hydrant.

DRAINAGE CANAL POWER FOR CHICAGO.

MR. FRANK WENTER of the Chicago drainage board is quoted as saying that the falls at Lockport, which belong to the Chicago sanitary district, will furnish more than enough power to generate electricity for lighting the city. It is said that 10,000 horse power might be obtained from the fall of water at that point.

"It was certainly a clever idea, the publication of the Data Sheets. I paste a small piece of plain paper to the heading of each subject; to serve as an index for "cross reference." Wm. H. Gordon, Girardville, Pa.

ELECTRIC LIGHTING.

THE PHILADELPHIA AND READING TERMINAL RAILROAD AND STATION IN PHILADELPHIA.

The new Philadelphia and Reading Terminal Railroad Station in Philadelphia possesses many points of extreme interest. In order to show the necessity for the erection of such a terminal as has been built, it may be stated that in 1891 the number of passengers carried by the Philadelphia and Reading Railroad was over 18,000,000, and in 1893 there were over 20,700,000, of whom about 10,000,000 arrived at or departed from Philadelphia. About 75 per cent of the latter might be classed as suburban; that is, comprised within a radius of 20 miles from the city. At the present time 294 passenger trains arrive at and depart from the terminal station daily. We append some data on the subject presented before the American Society of Civil Engineers by Mr. Joseph M. Wilson, C. E.

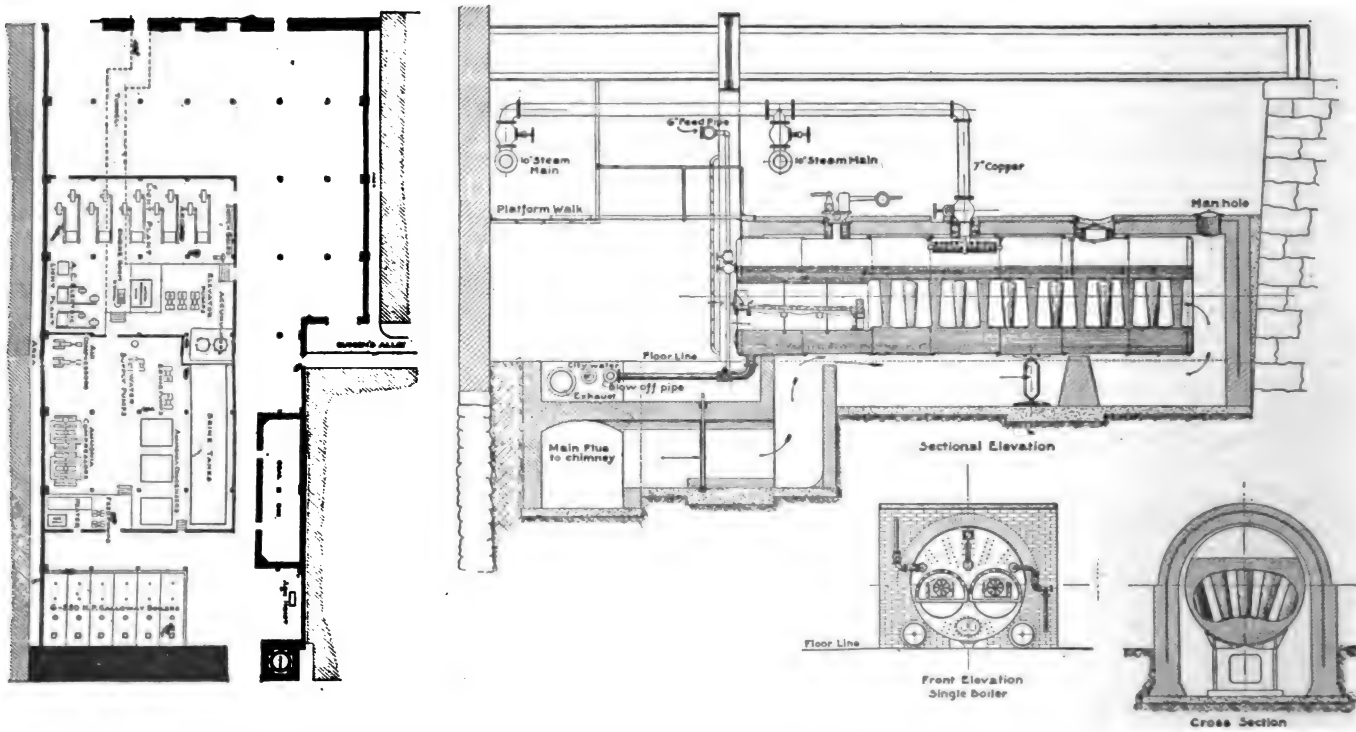
The electrical engineering work was done by the Philadelphia firm of M. R. Muckle, Jr., & Co.

The Power-House.—This building, located under the railway tracks between Arch and Cherry Streets and containing the operating plants for the cold storage and arc electric light system, and also the boilers, covers a space about 285 ft. in depth, 141 ft. in width on Arch Street and 114 ft. on Cherry Street. It is plainly and serviceably constructed of brick and stone, and does not require special description, the tracks overhead being carried by columns and girders. These tracks are laid on stone ballast on a corrugated floor, the corrugated steel pieces forming this floor being of a special section, which, it is believed, has never previously been employed. It was essential to obtain a water-proof floor, and the usual shapes of material would not furnish this on account of the positions of the riveted connections. It was therefore decided to use U-shaped troughs with horizontal outward flanges on the upper edges, and to connect adjacent pieces by a cover plate laid on top and riveted to the contiguous flanges. Some of the manufacturers bidding on the work claimed that this shape of piece could not be made, but it was successfully done by stamping cold from ⅜in. steel plates in 20-ft. lengths, at no greater cost than if the floor had been built with the usual shapes. The steel work was painted with P & B paint, and the hollows or troughs were partially filled and sloped for drainage with a composition consisting of a mixture of coal tar and fine gravel, which became very hard. The drainage is carried from these by a series of galvanized iron corrugated pipes to main drains, hung from the superstructure, and thence to sewers. The work has been a complete success, giving very dry and satisfactory rooms below for the purposes required.

Space is provided at the North end of the house for six boilers, and the stack is at the northwest corner. It is of brick, having a height of 150 ft. above the floor level of the boiler-room and an internal diameter of 7 ft., the base being square, changing to an octagon above, and finishing at the top with a neat cast-iron cap. The core of the stack, which is entirely separated from the external portion, is 13 in. thick at the lower part for a height of 60 ft., then 9 in. for a further height of 30 ft., and above that 4½ ins. The exterior is 2 ft. 6 in. thick at the square base, with 2 ft. 6 ins. additional on the interior corners, and the octagonal portion is 22 in. in thickness to a height of 60 ft. above the floor, thence 17 in. for 30 ft., thence 13 in. for 30 ft., thence 9 in. to the top. A large coal bin is provided, which is filled directly from cars on a siding track above, and a hydraulic hoist is arranged so that ashes may be raised and automatically dumped into cars for hauling away. The positions of the cold storage and the arc-lighting plants are shown by the drawings.

The Operating Plant of the Station.—The operating plant comprises the boilers, the heating and ventilation apparatus, the electric plant for the lighting of buildings and roadway, the pneumatic switch apparatus, the elevator machinery, the water supply and the refrigerating apparatus. The entire plant has been so arranged as to allow as much economy in working as possible under existing conditions, and at the same time avoid risk of stopping the operation of the road and station from accident.

The boilers, refrigerating machinery, pumps and accumulators operating the freight elevators, the air compressors for the switch system, the arc-light dynamo and engines, and the alternating-current incandescent light dynamos and engines are located in the power-house between Arch and Cherry streets. The direct-current incandescent dynamos and engines, the filters, tanks and pumps for supplying water to the station, the pumps and compression tanks, hydraulic engines, etc., for the passenger elevators, a relay of pumps and an accumulator for the freight elevators, and the pumps, etc., to discharge waste water to the sewer, are located in the basement under the central portion of the head-house on Market street.



ELECTRIC LIGHTING PLANT, PHILADELPHIA & READING TERMINAL, PHILADELPHIA.

Boiler Plant.—The boiler plant consists of six Galloway boilers, each containing 88 special interchangeable cone tubes, aggregating 1200 H. P., two feed pumps, four injectors, one horizontal tubular heater, a blow-off tank, a hot well and a hydraulic ash lift. The Galloway boiler was adopted for this location principally on account of the low head-room available, and also because such boilers are readily cleaned, and the character of the water which has to be used is such as to produce large quantities of lime scale.

The arrangements for the ventilation of the various apartments and stores of the building are admirable. A large number of 60 in. fans are driven by 5 H. P. motors, and a 42 in. fan by a 2½ H. P. motor.

The basement stores are ventilated from the floor by galvanized iron ducts and a 30 in. Huyett & Smith disc fan, driven by a

1 H. P. electric motor, the air being delivered at the rate of 6,000 feet per minute at the base of the pipe shaft, which has on top a 30-in. Star ventilator.

Arc-Lighting Plant.—The arc-light plant has a total capacity for operating three hundred 2,000 nominal C. P. arc lamps in 10 circuits, with a maximum of 30 lamps on each circuit. Two hundred and forty lamps were installed under the contract, distributed throughout the sheds, yards, streets, driveways, stations, &c., of the system.

There are 10 direct current automatic Western Electric arc dynamos, each having a capacity of 30 10 ampere 50-volt lamps, at a speed of 1,400 revolutions per minute, and guaranteed to operate with a power not exceeding ⅘ H. P., delivered at the dynamo pulley for each lamp burning. The dynamos are operated by five Westinghouse compound engines (one engine driving two dynamos), connected up with Schultz endless leather-link belts. This type of belt is used throughout the plant. Each engine has a 10-in. high-pressure cylinder, an 18-in. low-pressure cylinder and a 10-in. stroke, and at 320 revolutions per minute, with 100 lbs. pressure, and one-fourth cut-off, it is guaranteed to deliver 65 H. P.

The switchboard is of Tennessee marble, and is fully equipped with spring jacks, plugs, ampere meters, lightning arresters, magneto bell, voltmeter, etc.

The lamps are 2000 candle-power of two carbon Western Electric manufacture. All conductors are of No. 4 B. & S. gauge; those in the underground conduits have Simplex triple-braided double extra mining insulation, and those for all other work, triple braided weatherproof insulation.

Incandescent Electric Light Plant.—The incandescent electric light plant is served by both alternating and direct current dynamos. There are two 45-K. W. Westinghouse alternating current incandescent dynamos with separate exciters driven from the engines, each exciter having a capacity of 30 amperes at 125 volts, the primary current being 1000 volts and the secondary 100 volts. Each dynamo is driven by a compound Westinghouse engine with a 12-in. high-pressure cylinder, a 20-in. low-pressure cylinder and 12-in. stroke, rated at 100 H. P. with 100 lbs. steam.

In addition to the various circuits serving the lamps, a pair of No. 4 B. & S. mains is run to the 1,000-light converters, which are connected with the head-house distribution switchboard, and act as a relay to the direct current incandescent dynamos.

The direct current incandescent lighting apparatus serves all lamps in the head-house, the motors driving the ventilating fans and the dynamotors serving current for all the telegraph entering the building. There are three Westinghouse 75 K. W. multiple, direct current incandescent light dynamos, each of 600 amperes, at 125 volts. Each of these dynamos is driven by a Westinghouse compound engine, having a 13-in. high-pressure cylinder, a 22-in. low-pressure cylinder and a 13-in. stroke, and of 125 nominal horse-power, with 100 lbs. of steam (see Plate I).

The switchboard is of white marble, 18 by 9 ft., supported by brass pedestals. It has two pairs of bus-bars, one pair for alternating current and the other for direct current. The 36 circuits serving the building are each provided with a double pole, double throw, jaw switch, and four spare switches are supplied for additional circuits that may be needed. Each circuit is furnished with two cut-out switches on each pole, so that in the event of the failure of a fuse a second fuse can be thrown into circuit by the closing of the auxiliary switch. Each of the circuit switches is connected to both sets of bus-bars, so that when thrown up they feed the circuits from the direct current bus bars, and when thrown down from the alternating current bus-bars.

There are provided upon the switchboard for each dynamo its appropriate switches, rheostat, ammeter, voltmeter, and upon the top of the board an ammeter indicating the load on the alternating current dynamos in the power-house. This arrangement of the switchboard is somewhat novel, and was so designed as to utilize the spare power of the alternating current machines and avoid the necessity of a spare direct current dynamo.

There are also provided four rotary transformers of different sizes, taking the current at 100 volts from the switchboard and transforming it to 6 volts, 20 volts and 70 volts respectively, for the operation of all the telegraph lines in this building belonging to the road and its connections.

There are installed in all, including current for motors, an equivalent of 4,200 16 candle-power lamps. For general illumination one 16 candle-power lamp is allowed for 1,000 cu. ft. of content, which of course does not include special desk lighting. The entire wiring is run on the two-wire system. No wires less than No. 14 B. & S. gauge are used, and wires of No. 8 and larger sizes are stranded. The insulation is as follows: Simplex double extra mining for high tension alternating currents, primary circuits. For the secondary circuits, Bishop double coat. For the direct current incandescent wiring, fire and weather-proof insulation is used.

The general layout is figured for 16 candle-power 100-volt lamps with a loss not exceeding 5 volts; and a difference of 1 per cent. between any two lamps, on the same circuit with all lamps burning.

THE PHYSIOLOGICAL ACTION OF ACETYLENE.

BY DR. W. H. BIRCHMORE.

The introduction of Ethine as a commercial article and the proposition to use it as a means of lighting for domestic and other plants, especially for portable lamps, brings into prominence its possible influence on the human subject, and on animal life in general. The chemistry books have for years set forth that Ethine had poisonous influence on life, but the extent and kind of influence exerted has never been discussed at length or in detail by any person in connection with its commercial use. Indeed beyond the statements in the books referred to, the fact of its physiological action has hardly been questioned at all.

During the month of May last past it was my good fortune to be so situated that a daily study of some of its effects was possible, and although the narrative of the observations would have an interest of their own in connection with the action of gases on the blood they are not in order here. Certain General Conclusions were possible and as they have a relation to the commercial use of the gas they are given for what they are worth.

The amount of the gas that can be diffused in the air of a room without perception by the senses.

It is a well known fact that under pressure the amount of a gas that can be forced through water by the process of diffusion is a function of the pressure and also of a co-efficient that varies with each gas investigated, in the case in question it is very high. The published experiments of various authorities place the amount that may be dissolved in water at 60 F. as more or less exactly the bulk of the water; and it is a curious fact that this holds true of the watery vapor evaporated from a pan holding the water in which the gas has been dissolved. Carefully arranged experiments extended over a number of days showed that if the gas was under a pressure greater than that of the atmosphere in one part of the pan that the rate of loss was decidedly greater than the rate of evaporation of the water, in the other part, consequently while the loss from the pan under the pressure of the atmosphere was the same as the decrease in the water from evaporation, under the pressure that might arise in a gas meter the passage by the "transfer from next to nearest molecule" under a pressure of two inches of water could reach to twice this under the conditions of ordinary use. To decide this question in another way, an absorption apparatus was run from noon on Saturday to noon on Monday in the room in which was standing a holder that contained the gas under a pressure of two water inches. The space about the holder was in effect a quarter of a square foot. There was some Ethine in the air of the room when the experiment was commenced, as shown by the formation of the copper compound by passing the air through the test solution, but as the air in the room was known by measure to be changed once in every hour evidently if there should be shown to be a continued presence of the gas, it must come by diffusion from the holder. An apparatus was rigged that would pump air slowly through the test solution during the time of the experiment, and during the 48 hours under examination the amount of gas present was sensibly the same as at other times. This shows that the amount present came from the holder by continuous diffusion. This amount, which was about 10 C. CM. per hour for each square foot of exposed surface under a pressure of 2 inches of water was quite imperceptible to the sense of smell.

The amount of gas required to produce headache.

Twice in the course of my studies the opportunity occurred to measure the amount that diffused in the air of the room would produce distinct headache in the course of a short time, and it was found to be rather unexpectedly large as compared with the product of the imperfect combustion of the ordinary illuminating gases. As stated, the air in the room was known to be changed once in an hour. The cubic contents of the room was about 5,000 feet if a proper allowance is made for the space occupied by properties. The amount of gas diffused was 2½ cubic feet, or one in 10,000. Within 20 minutes a decided headache was noticed, with a sense of dizziness, that was a sufficient warning to get into fresh air. The second time the experiment was made of remaining until the sight was slightly affected; this proved very foolish, for in the course of an hour after leaving the room respiratory difficulty appeared, and in the course of a few hours nausea, and a prostration and sense of the impossibility of exertion that forced me to remain in bed all the next day. The effects were not those of sleep, but the exact counterparts of the subjective effects of the ether narcosis, hallucination and all. Three days afterwards the heart respiration ratio was so sensitive that an attempt to walk rapidly across the Brooklyn Bridge produced such a feeling of exhaustion as to compel rest.

The important fact in this connection is that a man well acquainted with the smell of Acetylene was twice in the room in the course of this experiment and on question afterward said that he did not notice anything peculiar about it, and *certainly* had not noticed the "smell of the Acetylene." It is possible that the

very familiarity with this smell may have blunted his perception, but at the same time it may be urged that he would have been doubly sensitive knowing the danger involved in breathing it. It is therefore safe to say that as much as one part in ten thousand may be diffused in the air of a room without being detected by the sense of smell in some persons, and that this amount can produce dangerous effects.

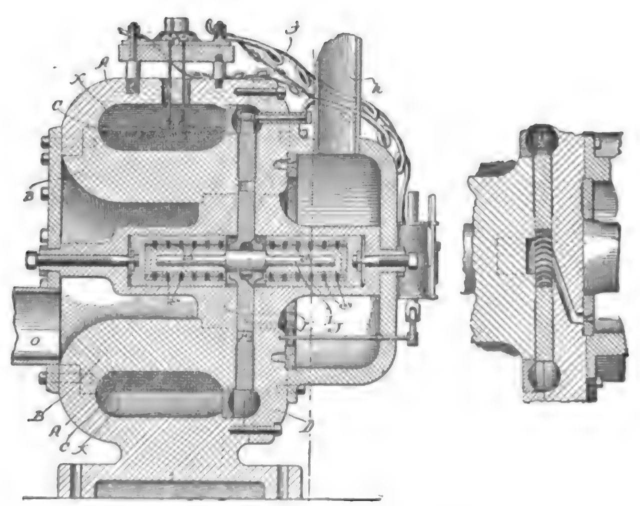
Can this dose of 1 *in* 10,000 *be considered fatal, and if so how long a time is required to produce this effect?*

Up to date there is no record of any attempt at "Suicide with Acetylene for the sake of Science," but an experiment on a guinea pig gave the following.

Alarmed at my own experience it seemed a good thing to know if a reasonable limit could be set to this sort of thing; so a large healthy guinea pig was confined in a tight box, containing 216 cubic feet. Experiment showed that confinement in this box under ordinary conditions for a period of 48 hours had no effect on his health, appetite, or spirits, although the air must have been much deprived of its oxygen, by the measure it sank below the proper respiratory limit for human beings, therefore I judged that any error that might get in would be on the safe side. At ten o'clock in the forenoon I drew out 35 cubic inches of air, and substituted Ethine; in about ten minutes my prisoner was evidently uneasy, and in half an hour was hid away under the straw, the usual habit of guinea pigs when in distress. They do not run about as do some animals, and when at four o'clock I opened the box my pig was dead and his blood had lost the power of absorbing oxygen almost as if killed by cyanogen. As the guinea pig is a rather hardy little beast under this sort of treatment usually, it seems certain that a man would or could be fatally injured by breathing a mixture of 1 in 10,000 of Ethine for 6 hours.

THE SARGENT STEAM TURBINE DYNAMO.

In order to obviate the necessity of employing shafting or other connection between an engine or motor and the generator which it drives, and at the same time to decrease friction and economize space, Mr. Charles E. Sargent, of Chicago, has devised what he calls a "turbine generator," in which the armature is revolved by means of jets of steam directed against a series of vanes, on the principle of the steam turbine. The arrangement and operation of the generator will be readily understood by referring to the accompanying illustrations. The outer ring A, Fig. 1, is constructed of paramagnetic material and provided with a base by means of which the entire machine may be fastened to its support. Within this outer ring



Sargent Turbine Dynamo.

and secured to it by means of bolts is an inner ring of similar material B, the meeting surfaces of the two being hollowed out to form an annular chamber X within which is a single field coil C wound upon the inner ring, its ends projecting through an opening in the outer ring. Upon the right-hand end of the outer ring A is fastened a third ring D, of paramagnetic material and forming with the right-hand end of the inner ring the poles of a cylindrical horseshoe-magnet. Within the inner ring B is fitted a diamagnetic journal-block E, and within two graphite bearings are mounted the opposite ends of a spindle I, upon which is the armature J, which consists of a metallic disc of steel arranged to revolve between the poles of the horseshoe-magnet. Brushes bear upon the outer periphery of the steel disc, and are connected with one terminal of the machine. The other terminal is connected directly with the outer ring A, which is one of the poles of the generator. A supply of steam is admitted through the pipe *h* under high pressure to the interior of the head, which connects with the disc chamber by means of a series of ports. The metal of the disc is cut away in the portion which revolves in front of these ports to form a series of curved vanes, separated by a series of passages of similar curvature. A second series of ports on the other side of the disc lead from the armature chamber into the interior of the ring B, from which leads the discharge-pipe O.

In order to provide means of balancing the disc at the very high velocity at which it runs, the springs, shown at e^4, are provided, encircling the bearings and allowing the disc to find its own centre of rotation.

Fig. 2 shows a section of one of the steam ports and the vanes of the armature disc.

Power Transmission.

THE PLANS OF THE SUSQUEHANNA RIVER ELECTRIC CO.

Mr. Clemens Herschel, of New York, the distinguished hydraulic engineer who, at the request of the bankers and capitalists interested, has for some time past been investigating the plans for the proposed electric plant at Conowingo, Md., to supply Baltimore with electric power generated by the waters of the Susquehanna River, has completed his investigations, and with a result highly satisfactory to the Susquehanna River Electric Company. Mr. Herschel, in his report, recommends the plans formulated by Mr. James H. Harlow, of Pittsburg, Pa., and, as he says, "without change, as the most advantageous plant which can be built in that stream"—the Susquehanna River. Mr. Herschel, in his report, also discusses the minimum flow of rivers generally, and says: "Whatever reasonable low water be assumed (unless a freak of nature be imagined to occur once in fifty years or a century, which might for a day or two bring the water of the river still lower, but with which no concern need be had), whenever the limit of minimum power of the works first built (for 25,000 horse power) shall be approached, a proper safeguard will have to be taken to insure against a deficiency by providing for additional water power on the lower site."

This remark applies to the proposed plans by reason of their being two falls, at each of which it is proposed to develop 40,000 horse power, and the minimum flow of the Susquehanna River, which is only about two per cent. of the time, produces 25,000 horse power at each fall. Therefore, Mr. Herschel means that when the horse power of the first plant is disposed of the company should proceed to erect the second proposed development.

"All water powers (unless we except an absolutely constant power like Niagara) can profitably be supplemented," he adds, "by steam power, the steam engines to run only during the weeks or months of a deficiency of power, and to stand idle at the comparatively small expense of the interest on the first cost of the steam plant when not in use. So that the low water flow by no means measures the amount of water-wheel capacity which may profitably be set in the powerhouse. On the contrary, this wheel capacity may advisedly be placed at many times the low-water flow. By furnishing one-eighth of the annual output of power by steam, presumably five times the low water capacity of the river may be furnished as water power for the other seven-eighths of this annual output; and when steam is used to the extent of five-sixteenths of the annual output of power, ten times the low-water flow may be utilized to produce water power. From this it will be seen that your plant could profitably be largely increased, and, as I understand, there is an available modern steam-electric plant in Baltimore at your command, which could be used supplementarily during the times of future low waters that have been referred to, you may deem it advisable to make your first water-power plant to provide for 50,000 horse power, or even more, capacity, instead of 40,000, as now suggested, and thereby notably increase your earning capacity.

"It may be proper, in this connection, for me to call to your attention that your market for power is not limited to the city of Baltimore, but may also be taken to include the city of Wilmington, Delaware, and generally all the territory within a radius of forty miles or more from the site of your powerhouse."

Mr. Herschel having made the above report, Engineer Harlow will now proceed to finally prepare the plans and specifications for the erection of the plant, and it is said that these will be ready, and bids for the construction of the hydraulic work invited, in about sixty days.

A THREE-PHASE PLANT FOR CANADA.

The first three-phase electric light plant in Canada has been contracted for by the Trenton Electric Company. The William Hamilton Manufacturing Company, Peterborough, Ont., has secured the contract for putting in the entire water power machinery, and it is understood that the Canadian General Electric Company will furnish the electrical appliances necessary.

ELECTRIC TRANSPORTATION DEPARTMENT.

A PLEA FOR THE MOTORMAN.

BY A. E. D.

Electric traction is at one disadvantage as compared with steam, viz.: the business is still so new that many managers are not yet educated up to the idea that a motorman should have a large average intelligence, a certain amount of technical skill, and quick judgment to act promptly in emergencies. Any one can twist a brake or turn on a controller, but the number of accidents and the amount of poor judgment we often see displayed, proves that every man who can start and stop a trolley car is not a good motorman. You cannot have good motormen without educating them to their positions and taking some interest in their work and showing them that their efforts to do better work is appreciated. Some companies are beginning to find this out and by organizing competitive examinations, distributing prizes, etc., strive to interest the men in their work. And they will find that it pays, for in seeing their work appreciated the men will take pains to make a good showing. As the work improves and managers become better acquainted with the real nature of it, wages will go up, which in turn will attract a still better class of men and insure still better work.

At present in some large cities a man will not work as motorman who can find anything else to do, and instead of being looked upon by his fellow workmen as engaged in an honorable occupation he finds himself ranked with hostlers and mule drivers. His long hours on his feet are wearing on his temper and nerves, and low rates of pay discourage any efforts at improvement. The result of all this is, that small towns have the best men and large cities have the poorest while the condition should be just the reverse. The reason of this is plain. In the smaller towns the pay is relatively much higher than in the cities and superintendents can therefore get a better class of men. Men who have positions as motormen are regarded by their fellow laborers as holding very good places and are treated accordingly. Then the superintendent takes a personal interest in the men and sees to it that before they take a car they are fit to run it. He takes pride in the fact that he has good motormen and the men reciprocate by taking pride in their work and their company's road. He also calls upon the extra list when he needs men to make repairs, and help around the station, etc.; and endeavors to make them acquainted with the car machinery. He also encourages them to read the electrical papers (for there are always two or three to be found around each country station) with the result that the men can tell the comparative merits of different types of motors, can take hold and help anywhere, from winding a field to building a line; and if called upon for severe or extra duty they will respond cheerfully and faithfully.

Now, do not sneer at comparisons with small cities, for electric traction owes its progress largely to them. In Western towns of 5,000 population you will find the latest appliances and the newest wrinkles, while horse cars are still to be found in New York City, and its elevated roads are still using dirty, foul smelling cars and smoky, cinder-producing engines. The first electric roads were built in cities of less than 100,000 inhabitants: remember that. A motorman should be taught to feel that he is a skilled laborer and treated as such, and should be made to know that there is more to his business than merely turning a controller handle. If he knows, for instance, how the machine under his car is put together he will not try to run his car up hill or around curves at full speed, or throw on the full head of current before the car gets under way. But especially should he receive a thorough training in emergency stops. There will be times when he will have to do the right thing and do it instantly or have a serious accident; and yet there are men who seem to lose all self-control at such times. Such men should never be allowed to take out a car until they have had a thorough course of training, for even a very nervous man can be trained to act coolly in the face of danger. You very rarely hear of telegraph linemen, sailors or locomotive engineers losing their self control, because their positions are those of constant risks and their daily training familiarizes them with danger and how to meet it when it comes.

A railroad engineer has to serve a four years' apprenticeship and become thoroughly familiar with his duties before he is allowed to touch a lever and while the simplicity of the motor makes a long preliminary service unnecessary, yet it should be long enough and thorough enough to command respect and the inducements should be great enough to tempt the better class of men to seek it. An engineer gets from three to four dollars a day for eight or nine hours run, while a motorman receives about half that for longer hours. An engineer can sit on a cushioned seat during his entire run, while a motorman must stand. An engineer has a clear track ahead from one station to another, though of course both he and the fireman keep a sharp lookout ahead. The motorman has to work his way among trucks, carriages, bicycles and pedestrians, besides keeping a lookout for passengers and being expected to come in on time without violating certain speed ordinances. An engineer while running has to look after his lever, his brake valves and his pump, his fireman taking care of the sand box and ringing the bell when necessary. A motorman has to take care of his controller, reversing lever switch, sand box, gong and the clumsy hand brakes. Meanwhile the machine under his care is a profound mystery to him and replacing a burned out fuse is as much as he ever learns. He requires all the nerve and presence of mind of the engineer and greater watchfulness and fully as much intelligence.

But the engineer has several advantages with company managers over the motorman, as follows: A locomotive costs about $10,000. A car can be equipped for about one-twelfth of that sum. A locomotive runs at high speed at distances of from two to four hundred miles from its round house, while a motor car travels at slow speed and does not get over ten miles away from its car barn. A locomotive is a comparatively delicate piece of machinery and needs constant watching, while a motor will run for days under conditions that would totally destroy a locomotive in as many hours. If a locomotive becomes disabled on the road, it makes a great deal of trouble and delay till another one can be run out to push it in, while a motor car can be handled by the next car that comes along (an argument in favor of small units in long distance railroading).

An engineer's work is watched and appreciated. A record is kept of his time, in running, of his consumption of coal and oil, and the general condition of his engine, and each month this record is posted up in the round house for all the other mechanics to gaze at; and if his record is a good one he feels that he is in line for promotion. Steam railroad managers have found out that it does not pay to keep men on duty too long at one time, and accordingly arrange their running schedules to fall as close to the eight hour limit as possible. Electric traction men will have to learn the same lesson. It may, if they are small, narrow minded men, cost them a great deal of money to learn it, but it will have to come. Men who are nervous, tired, and cross, are not fit to run a motor car. They are just in the condition to run into a truck or run down a pedestrian through carelessness.

Some improvements should be introduced in the equipment of cars. THE ELECTRICAL ENGINEER has long and consistently advocated quick-acting brakes and the companies that do not adopt them will soon be compelled to do so by legal force. A motorman with the present hand power brakes loses considerable time in applying the power. The following table shows what the loss of from one to two seconds at a critical moment really means.

Miles per hr.	*Feet per Sec.*
6	8½
8	12
10	15
15	22
20	29½

Proper fenders are, of course, a necessary car equipment in cities of the first class, and managers are only running against a stone wall in opposing their use.

The controller handle is a big clumsy contrivance that could just as well be placed at the side and worked like a lever. This with an air-brake equipment would allow the man to sit except in the most crowded parts of the city and he could do just as good work sitting as standing.

If a cheap recording ammeter could be placed on each car, and a record taken each trip and preserved, it would make the man more careful of his current supply and insure better work all around. It would also be a good index of the power required on different parts of the road. Trolley managers should be as broad minded and capable as steam railroad managers. Cities of the first class like New York, Brooklyn, Philadelphia, Chicago and St. Louis have more miles of track, employ more men and carry more passengers than many extensive trunk line systems, and the day for the man whose chief recommendation is his "pull" has passed. Trolley roads depend upon the public for existence and patronage, and are judged largely by the character and courtesy of their employees; and the managers who pursue a "public be d—d" policy will find that the public outnumber them several thousand to one and will soon find themselves confronted by hostile legislation in every direction which will at least cost them a great deal of time, anxiety and money to defeat. As now, in the Brooklyn elections, the records of candidates will be thoroughly investigated as to their "trolley and anti-trolley" influence. One official has

already been consigned to political oblivion on account of supposed friendliness to certain trolley interests; and others will follow. No better object lesson is needed.

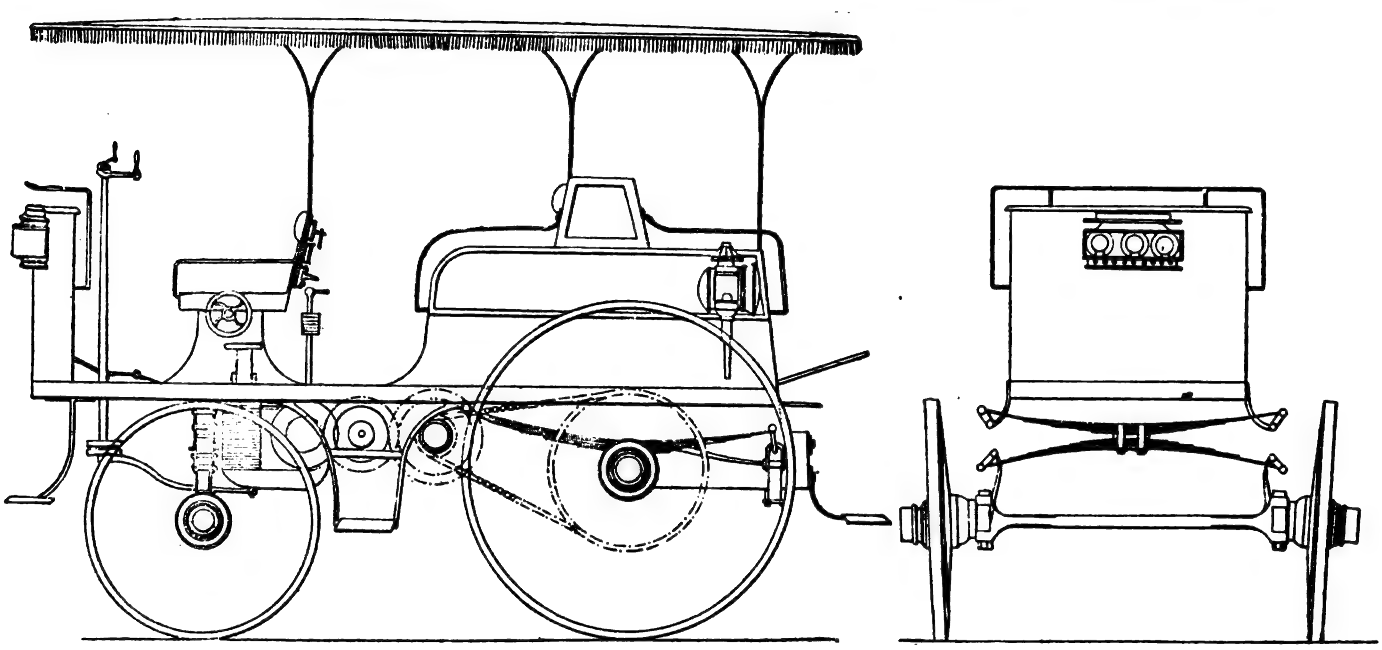
THE JEANTAUD ELECTRIC CARRIAGE.

Among the vehicles which took part in the Paris-Bordeaux races last June, was the electric carriage built by M. Jeantaud, and illustrated in the accompanying engravings. As will be seen the carriage has three seats, for two persons each. A box under the rear seat carries the batteries. The wheels are of hickory, the front wheels being 40 inches in diameter, and those in the rear 55 inches. The loads which they carry are divided proportionately to their radii, that is to say, 1,980 lbs. on the front, and 2,860 lbs. on the rear wheels, making 4,840 lbs. in all.

As shown in Fig. 2, the front wheels are pivoted to the axles, which gives a very sure and easy method of steering the carriage. The front suspension is secured by means of two springs joined in the centre, as shown in Fig. 2. By this arrangement very elastic suspension is obtained. The journals of the axle are 1.8 inch for the front and 2.2 inch for the rear axles. As a result of an accident after leaving Paris on the day of the race the rear axle heated during the whole run, which necessitated stopping every hour for it to cool down, and for lubrication. At the end of the race it was found that the hub gripped the axle tight.

The braking arrangement consists of an instantaneous brake, obtained by a winding around the nave of the wheel. The brake is worked by a circuit breaker, placed under the foot of the motorman. There is also a progressive brake, which is worked by means of two hand wheels, one on each side of the front seat, and finally another brake in case of a rupture of the chain on grades. The mechanical part consists, first of a shaft carrying the differential gear, and operating the wheels by means of two chains. The differential gear permits of speeds of from 7½ to 15 miles an hour. A de Bovet magnetic clutch was to have effected the change in speed, but the construction of the apparatus was delayed, and the usual gear had to be employed for the race. The motor was designed by M. Rechniewski, chief engineer of the Postel Vinay Co. The efficiency on test was shown to be 68 per cent. at 2.4 H. P.; 92½ per cent. at 6.5 H. P.; and 89 per cent. at 10.4 H. P. Its weight is 495 lbs. and operation throughout the run left nothing to be desired; although designed for 7 H. P. it was frequently called upon for 14 H. P., to which it responded without a spark at the brushes. For the race in particular the regulating apparatus was so placed as to be controlled by the person sitting in the second seat.

The batteries were of the Fulmen type, and consisted of 38 elements contained in a dozen boxes. Each element weighed 33 pounds and the entire capacity was 300 amperes, at a normal discharge of 10 hours. With 70 amperes normal discharge this corresponds to nearly 2.7 amperes per pound of plate. The capacity of the battery is 210 ampere hours at the highest rate of discharge, and permits of running three hours, at the speed of 14 miles an hour on a good road. After the race the batteries, which had been transported and retransported several times by rail, came back to Paris and were found to be intact. Each battery weighing 1870 lbs. complete, and drove the carriage 25 to 44 miles, according to the profile of the road. The changing of the batteries required ten minutes at each station.



Figs. 1 and 2.—The Jeantaud Electric Carriage.

SOLVING THE EMERGENCY BRAKE PROBLEM.

BY WALTER E. HARRINGTON.

The instructions furnished by the manufacturers of electric street railway motors, covering the method of emergency reversal, of throwing overhead or main trolley switch and then reversing, throwing motors into multiple relation, followed by momentum of car running one motor as a generator and the other motor as a motor thereto, have not been very successful. Repeated cases have been observed wherein the motors failed to act upon throwing the switches as above described.

Messrs. Markle & Thompson of Hazelton, Pa., Mr. C. H. Hutchings of Wilmington, Del., Mr. C. F. Uebelacker of Jersey City, Mr. E. J. Moore of Trenton, N. J. and others have noticed the fact that motors fail at times to act when switches are thrown as above described. Cases have been cited where the "Sperry" or "Bonta" brake system was employed. While the plan would operate excellently when the "day was early and the brush contact on commutator good, yet at end of day when brush contact would be bad due to dirty and burned condition of commutator, the system would fail;" failure being ascribed, and very properly, to the inability of the motor to "build up" owing to the high resistance in the circuit. While this phenomenon of failure to "build up" is well known in central station practice, it has only very recently been observed in street railway motors when employed on the self-braking principle.

It occurred to the writer that if the motors were given an "initial magnetization," the "Sperry" or "Bonta" action would of course be obtained. To test this, automatic magnetic circuit breakers were placed on different cars on different railways, conditions varying, using equipments and cars of various makes and sizes. The magnetic circuit breaker employed was one designed by the writer, wherein all arcing at the main switch break is entirely prevented by the use of a small size copper fuse in shunt thereto. This feature of construction of the magnetic circuit breaker is here mentioned, as the small fuse plays an important role in addition to its arc preventing qualities. This new role will be described later. The idea is that by using an automatic magnetic circuit breaker, on a trolley car, instead of taking the valuable time, when seconds are hours, to throw the overhead switch in order to immediately reverse up to the multiple position, of course, the rush of current from the line will open the car magnetic circuit breaker, thus saving the power house. The very current that opened the car circuit breaker will give the motor or motors their "initial magnetization" followed by the "Sperry" or "Bonta" action. Every test made fully confirmed this view and established the fact without any doubt that a magnetic circuit breaker on a trolley car is an indispensable adjunct, if for no other consideration than to use in the event of emergency reversals.

In several tests where the magnetic circuit breaker was set low,

say, at 100 amp. adjustment on, say, G. E. 1,200 equipments, upon reversal, while motors were still in series relation in passing to the multiple relation, the magnetic circuit breaker would open. It is here the copper fuse in shunt to main break of switch would enter in and contribute its share by lagging and not "blowing" until motors were in multiple and motor resistance all cut out.

(Mr. Harrington accompanies this article by data of several tests going to prove the view he takes and the statements he makes above. The set of tests at Wilmington, Del., is appended.)

TESTS MADE ON WILMINGTON, DEL., CITY RAILWAY.

Oct. 31, 1895.

Car body 20 feet 6 in. St. Louis make. No. 3 Westinghouse motors. G controller. "Brill" truck. Weight of car 18,000 pounds. Tests were made running down a 5 per cent. grade, track wet and more or less covered with Autumn leaves. In all the tests the speed at reversal was about ten or twelve miles per hour.

Test No. 1.—Reversed to multiple. Circuit breaker opened and fuse "blew" a little before car came to rest. Motors acted on "Bonta" or "Sperry" principle, very satisfactorily.

Test No. 2.—Connected with Weston ammeter. Reversed. Circuit breaker opened and fuse "blew" some little time before car stopped. "Sperry" and "Bonta" action very pronounced. Could not read ammeter on account of jumps. Car came to rest in about a car length. That is, the momentum was overcome and the hand brakes could then hold the car.

Test No. 3.—Reversed and motors flashed to ground. Circuit breaker opened from the grounding of motor more than other cause. This was noticed by reason of the pronounced manner in which the circuit breaker acted, notwithstanding the car was brought to a standstill in about the same conditions recorded in above test.

Conclusion:—The above tests demonstrate that 125 ampere adjustment is ample for car under the above conditions, and that a car would be brought to rest under the different conditions which would be imposed upon it in practice.

WALKER ELECTRIC RAILWAY APPARATUS FOR EUROPE.

Messrs. F. De la Briere and C. La Blanc, of France, came to this country recently as the representatives of a group of French capitalists, with the purpose of securing the control for Europe of American electric railway apparatus and appliances. Mr. La Blanc was formerly associated with the electrical engineering staff of the General Electric Co. in Europe, and Mr. De la Briere represents large iron and banking interests. The capitalists in question have in mind the reorganization on an electrical basis of several old horse roads, and have already secured eleven concessions or franchises for that purpose. The two gentlemen named above visited Cleveland recently and before they left there made contract arrangements for the extensive introduction of Walker apparatus on the Continent of Europe, especially in connection with the proposed new railway work. Six Walker motor car outfits will be shipped to the syndicate immediately. In spite of the freight, and duty at the rate of 45 cents per 100 kilos or two pounds, the American apparatus is regarded as superior and desirable.

MORE THAN ONE WAY OUT.

ON Water Street, Brooklyn, the trolley wires of the Seventh Avenue and Smith Street lines parallel each other very closely. A few nights ago the Seventh Avenue circuit was temporarily broken and the following conversation took place on one of the cars. Said the motorman: "An' is it the power that's giv' out?" "Yis," answered the conductor. "Thin put yer trolley on the Smit' Strate wire." The car at once proceeded with the "borrowed" power, while the grateful passengers predicted that the motorman would some day own the road.

TROLLEY LINES IN CONNECTICUT.

Plans have been completed for the extension of the tracks of the Waterbury trolley system to Waterville, a distance of three miles. The new line will parallel closely the Naugatuck division of the New Haven Railroad Company. The latter has objected to a plan for an overhead bridge, which forms part of the extension of the Middletown trolley system to Cromwell, paralleling the valley division of the New Haven Company. The extension of the Middletown Company will therefore be postponed until next spring.

The Common Council of New Haven has concurred unanimously with the Aldermen in imposing an annual tax of $700 a mile on a local trolley company as a condition of allowing it to occupy a new street.

THE NEW GOUBET ELECTRIC BOAT.

A special dispatch from London states that a submarine boat has just been completed by M. Goubet on the Seine for a foreign Government. It is cigar shaped, 26 feet long and nearly 6 broad, of bronze, and weighs ten tons. It is divided into three portions, and everything is arranged so that heavy articles can be kept in their places, and that no risk will be run of disturbing the balance essential to stability, the craft always keeping parallel with the surface. This boat, the inventor maintains, can be manœuvred in one spot by the skilful working of pumps and arranging of water ballast. A weight of 2,500 pounds is attached to the keel in such a manner that it can be got rid of at any moment. In the event of a sudden rise to the surface being imperative, the boat would respond to the call with the lightness of cork. Compressed air contained in steel tubes is supplemented by caustic potassium and chlorate of chalk, for the removal of vitiated air. Thus, it is calculated that a crew of three persons might stay under water from twelve to fifteen hours without danger. It will be propelled by a one-horse-power electric motor at a speed of nine knots. The boat has been constructed for naval purposes, and material for letting off torpedoes by means of compressed air through the single pulling of a trigger is provided. Trials of the boat were made in the Seine a few days ago.

TALENT FOR THE ELECTRIC RAILWAY BUSINESS.

A street railway manager of our acquaintance has received many applications for a job, but none more earnest than this:—

dear sirs I have benadvised to write to you for A job on the St car as ime young and Active dear sirs if you want such A one please write me at once & Ill honest business & no other. Ime young & if you need A hand & wish to try me ill go & if i dont do your work down me & get some one else I neve see A street car but ive neve tryed to do any thing with out strike at it ive been examined by a phenoligist & he said that I was suited up for mashinery & Ime ready to be ex amined by the best phenoligist if you wish to have me axamined please rite at once.

THE CHICAGO MOTOCYCLE CONTEST.

Owing to the unreadiness of many of the competitors, the *Times-Herald* motocycle race that was to come off on Nov. 5 (Election Day) has been postponed until Thanksgiving Day, Nov. 28, when a goodly number expect to be in line. A kind of consolation race was indulged in by one or two of the contestants, as a preliminary canter, but none of the electric vehicles participated. The firms and individuals interested in motocycles are forming an organization.

IS THE SWEATER A TROLLEY UNIFORM?

The conductors and motormen of the Paterson, Passaic and Rutherford Trolley Line have been talking of ordering a strike because of an order issued by the new manager, Morton E. Davis, directing them to wear white collars and shirts while on duty and to refrain from the use of sweaters. The men say that white shirts are all right in cities, but that on a line running through country districts they would be ruined on one trip. Another order to which the men object requires them to clean their cars every morning. This work would occupy an hour, for which they get no extra pay.

In Cleveland, the "Big Consolidated" Street Railway Co. has also ordered its men to discontinue sweaters,—at least not to wear them over regular shirts. The men say they need the sweaters for warmth.

QUICK LAYING OF TROLLEY TRACK IN CHICAGO.

All the records in the way of street railway building were broken in Chicago on Nov. 4. The Chicago City Railway Company after massing men and materials for sixteen hours, began work on Indiana avenue at Thirty-ninth street with the beginning of the day, and by 10 o'clock had turned the horse car line from that point to Fifty-first street into an electric road. Three hundred men in that time planted a mile and a half of poles and strung the necessary wire. At 10.42 o'clock a car propelled by electricity went over the track.

A CURIOUS TROLLEY CONTEST IN KANSAS CITY.

A curious contest has arisen in Kansas City between the Metropolitan Street Railway Company, a trolley line, and the Missouri, Kansas and Texas Trust Company. The latter organization wishes to control the street lines acting as "feeders" for the Wyandotte Street Railroad station. To this end, it is appealing for consents of property-owners, and offers to the town in return for a franchise to light Wyandotte street with electricity and yield 2 per cent. of its gross receipts to the city, also to sell tickets to children twelve years of age or under, at the rate of twenty-four for a dollar, and to establish a universal four-cent fare at the end of the first two years the road is in operation. The Metropolitan Street Railway, claiming to have spent much money in securing monopoly, is fighting the application.

TROLLEY TO CARRY BREAD IN JERSEY CITY.

Mangels & Schmidt, the New Jersey bakers, are proceeding with the erection of their receiving and distributing depots in Jersey City, where the loads of warm bread which it is proposed to ship from Newark by trolley express in the near future, will be received. The bakery is one of the largest in the country. Spurs will be built into the bakery at Fifteenth avenue, Bergen and Hunterdon streets, and into the depot at the other end of the line, so that the trolley cars can be loaded from the ovens and unloaded into the wagons.

ACCUMULATOR TRACTION FOR CHICAGO.

J. G. Shaffer, representing a syndicate of capitalists from Chicago, New York and Philadelphia, closed negotiations last week for the purchase of the franchises of the Englewood and Chicago Electric Railway, and the Chicago and Morgan Park Street Railway Lines. John W. Green represented W. V. Jacobs and other stockholders of the old company in the sale of the franchises. The purchase was conducted by Charles F. Griffin, former Secretary of State of Indiana, now of the firm of Olds & Griffin. The syndicate that purchased the franchises is not the Electric Storage Battery Company, but includes stockholders in the Electric Storage Battery Company, among whom is Isaac L. Rice, Chairman of its Executive Committee, and lately active in the affairs of the Reading Road. The road is to be equipped with storage battery cars.

BIDS WANTED FOR A BALTIMORE ROAD.

Proposals will be received at the office of Mr. H. T. Douglas, President of the Baltimore & Catonsville Construction Co., Baltimore, Md., on or before November 15th, for furnishing and erecting the engines, generators, boilers and auxiliary equipment of the Power Plant required by the Baltimore & Catonsville Construction Co.

Specifications may be had on application to Mr. S. W. Huff, the electrical engineer. The company reserve the right to reject any or all proposals.

ELECTRICITY MAY BE SUBSTITUTED FOR STEAM ON BENNINGTON RAILROAD.

Superintendent E. D. Bennett of the Bennington and Rutland Railroad of Vermont, has been consulting with electrical engineers as to the feasibility of substituting electricity for steam power on the branch line between Bennington and North Bennington.

"HOWARD" ON HAIN.

THE following is from "Howard's pithy column in the *New York Recorder*:

"Col. Hain says electricity is not likely to be used next year nor for many years to come on the elevated road."—Report.

"Jay Gould told me, at least eight years ago, of his great interest in electric experiments and the progress made by experts in the use of this marvelous fluid. Jay Gould, unfortunately, is gone, but the property remains. Is it possible that Jay took with him all the pluck and enterprise and esprit of the overpaid corporation?"

TROLLEY EARNINGS IN BALTIMORE.

The City and Suburban Street Railway of Baltimore reports for the fiscal year ending June 30:

	1895.	1894.	1893.
Gross	$751,720	$605,128	$474,756
Operating expenses	546,970	409,368	367,782
Net	$204,750	$195,760	$106,973

Estimated net for three months ending September 30, $129,160.

TELPHERAGE COMING.

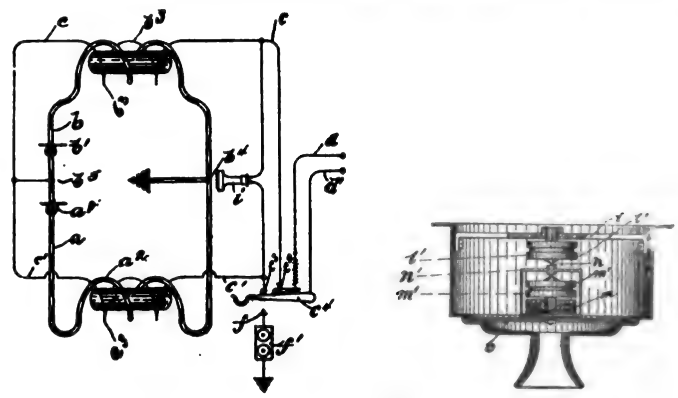
A complete and immediate revolution of transportation methods, involving a reduction of freight charges on grain from the West to New York of from 50 to 60 per cent., is what is predicted in the November *Cosmopolitan*. The plan proposes using light and inexpensive corrugated iron cylinders, hung on a slight rail supported on poles from a cross-arm—the whole system involving an expense of not more than fifteen hundred dollars a mile for construction. The rolling stock is equally simple and comparatively inexpensive. Continuous lines of cylinders, moving with no interval to speak of, would carry more grain in a day than a quadruple track railway. This would constitute a sort of grain-pipe line. *The Cosmopolitan* also points out the probable abolition of street-cars before the coming horseless carriage, which can be operated by a boy on asphalt pavements at a total expense for labor, oil, and interest, of not more than one dollar a day.

TELEPHONY AND TELEGRAPHY.

THE DEAN LOCAL TELEPHONE TRANSMITTER CIRCUIT.

The accompanying diagram represents a telephone transmitter circuit recently devised by Mr. Wm. W. Dean, of St. Louis, Mo., for increasing the effect of the changes of current in a transmitter. As will be seen two microphones are provided, one in each of two parallel circuits, both connected with a common diaphragm so that as the resistance of one circuit is increased that of the other is diminished. The current flowing through the second path is thus increased by both causes.

The local transmitter circuit, Fig. 1, is shown in heavy lines and comprises the two branches a and b. In the branch a is provided a microphone a^1 and the primary winding a^2 of an induction-coil. In the branch b is provided a microphone b^1 and the primary winding b^2 of an induction-coil. The secondary windings a^3 and b^3 of the induction-coils are included in series in the telephone-circuit, being connected by conductors c and c^1 with contact-points c^2 c^3, against which the switch-hook c^4 rests when the telephone is removed to close the circuit through the limbs d d^1 of the telephone line, which extends to the central station and terminates in the line-springs d^2 d^3 of a spring-jack. The line-spring d^2 normally rests upon a contact d^4, connected through an indicator and battery to ground. At the subscriber's station is provided a contact f, connected to ground through a bell f^1. The hook c^4 normally rests upon contact f.



FIGS. 1 AND 2.—DEAN TELEPHONE TRANSMITTER.

When the subscriber removes his telephone from its hook, the hook c^4 breaks contact with the contact f, thus opening the circuit of the battery through the indicator, by means of which the signal for connection is conveyed to the operator.

The receiver i is provided in a bridge between the two conductors c c^1 and the local transmitter-circuit is connected to ground at b^4 and is connected at the point b^5 with the conductors c c^1.

Fig. 2 shows a transmitter comprising two microphones operated by one diaphragm. Upon the supports l and m are the carbon buttons l^1 and m^1. Between the opposed faces of the carbons is a pin n, carried upon a bracket n^1 which is mounted upon the diaphragm o. As the diaphragm vibrates, the contact between the pin and the carbon buttons is varied, the pin making more intimate contact with button m^1 and a simultaneously weakened contact with button l^1, and vice versa.

In operation the pin and button n and l^1, respectively, are included in the branch a of the transmitter-circuit, while the other pin and button are included in the branch b.

TROY, N. Y.—The Troy Telegraph and Stock Company has been formed to maintain a line of telegraph or telephone from Troy to New York and the principal cities and towns of Westchester and Kings Counties, and the State of New Jersey; also to Chicago, Louisville, Lexington, and Covington. Ky.; Nashville and Memphis, Tenn.; New Orleans, St. Louis, Baltimore, Washington, and Montreal; capital stock, $2,000. Directors: Thomas Hogan, of New York City; Peter J. Turner, Patrick E. Purcell, Patrick J. Delaney, and William Miller, of Troy; Eli Galaise, Jr., of Cohoes, and Charles G. Teeling, of Green Island.

SUMMIT HILL, PA.—A new telephone company has been organized at Summit Hill in opposition to the Pennsylvania Telephone Company. Its promotors are Dr. T. W. Renshaw, and William and Joseph Schneider, of Summit Hill, and Dr. E. H. Kistler, James W. Maloy and D. A. L. Davis of Lansford. It is the intention to connect first Summit Hill and Lansford and afterwards extend to Tamaqua and Mauch Chunk. The line will be built by the Reading Electrical Construction Company, of Reading.

TELEPHONIC EXPERIMENTS WITH BARE CONDUCTORS LAID ALONG THE GROUND.

For many years bronze wire has been used by the German Postal Telegraph Administration as a conductor for telephone lines, on account of its conductivity being superior to that of the usual iron or steel wires. Besides bronze wires covered with copper, a number of German makers have also brought out numerous double-metal wires, under the names of compound wire, bi-metallic wire, double-metal wire, double-bronze wire, and patent bronze wire, &c. These wires have a core of steel or aluminum-bronze, with a high tensile strength, and are covered with copper or bronze of a high conductivity. Experiments with these wires were made in order to see if they could compare with bronze wire for telephonic purpose, both in respect to their mechanical and electrical properties. It is claimed for these compound wires that they have important properties. For example, a telephone line with a bi-metallic conductor will work much more perfectly than with a conductor of a single metal such as copper. Again, it is claimed that less insulation is needed for such a conductor than for copper or any other material, and hence such wires laid on the earth without special insulation permit of telephonic communication to a much greater distance. A number of experiments were recently conducted for the German Post Office by its telegraph engineers to ascertain the facts.

The results obtained do not go to show that the double-metal wires are any more valuable than the pure copper wire, but that the distance to which telephonic transmission by bare wires laid upon the earth is possible depends mainly upon the size and weight of the wires, presuming all the conditions are similar.

NICKEL-IN-THE-SLOT TELEPHONY IN CHICAGO.

The Chicago Telephone Company has decided to place in extensive use the dime-in-the-slot telephones, and has just sent out a canvasser, who is offering the automatics to druggists free of rent, with the agreement that the renter will receive one-half of the annual proceeds above $200. If a druggist shall refuse to accept these terms the company will allow the nearest express office, or similar place, the use of the telephone.

Mr. A. S. Hibbard, general manager of the Chicago Telephone Company, said last week on the subject:—

"Our company insists that the pay stations be pay stations. We cannot afford to keep our employés and our wires busy tending to gratuitous calls. Our business is peculiar in that an increase in the volume does not allow a simplification of methods, but rather makes things more complex Each new telephone makes possible some 10,000 new local combinations.

"We made a liberal offer to the druggists some months ago, but many of them refused to accept it. As we now offer the telephones free of rent and with the added inducement of a probable revenue, we are no longer dependent upon the druggists. In case they don't wish the telephones, we'll give them to their neighbors who do. We are determined to give the public a better service and we can do so only by first putting in the copper metallic circuit and then keeping the number of calls within reasonable limits.

"Owing to the advent of the overhead trolley, our present service has become so inadequate and unreliable that important messages are no longer intrusted to the ordinary telephone. The new telephones have a complete circuit of copper wire and obviate all the defects. Moreover, so long as persons have free access to the telephones serious business often has to wait. It is almost impossible to reach certain drug stores by wire.

"Instead of charging the public through the druggists, we shall make the charge direct. We put our agent on the road several days ago, and within two months the long-distance slot-machine circuit will be in use in every part of Chicago."

THE SOUTHERN NEW ENGLAND TELEPHONE CO.

The Southern New England Telephone Company circular to be issued soon to stockholders, announcing an increase of 10 per cent. in stock, says that subscriptions must be made on or before the 15th of this month, payment to be made in 50 per cent. installments of the first of next December and first of next March. The new stock will be issued on the first of next April, and participate in the dividend of next July. The proceeds of the sale will be used in the extension of the plant of the company, the stations of which, all furnished with long-distance transmitters, have increased during the last year from 5,529 to 6,565, each new station costing an average of $125. The long distance service inside the State shows an increase of receipts during the year from $6,500 to $9,000 a month. It is also officially stated that the company has 7,000 miles of wire, 400 miles of pole wire, and 15 miles of underground cable, the latter at ten of the largest exchanges in the State, where 14 out of 168 towns are now reached by the company's wire. The gross earnings during the last four years have increased from $330,000 to $500,000, and the net earnings applicable to dividends from $42,000 to $120,000. The circular states that the Bell Company has subscribed for its proportion of the next stock to be paid for in cash. The increase of stock is from $1,500,000 to $1,650,000. The present stock is selling around par.

BIDS INVITED FOR A CHILEAN SUBMARINE CABLE.

The Chilean Minister, under instructions from his Government, will soon advertise for proposals for the laying of a submarine cable from Port Montt to Punta Arenas. (Sandy Point). The Chilean Government invites bids from the United States, France, Germany and Great Britain. The bids will be open to any country until December 5. The cable that Chile proposes to lay is to connect the southern portion of the country with the principal cities, in order to facilitate news of the happenings of Lower Chile. Under the present conditions the only means of communication is by steamer to the principal ports.

TELEPHONE NOTES.

TOLEDO, O.—The Spitzer Building annex is to be occupied by the Central Union Telephone Company.

RICHMOND, O.—The Eastern Ohio Telephone Co. has been formed; capital stock, $5,000.

GREENVILLE, ALA.—A telephone exchange for Greenville may be considered an assured fact.

NYACK, N. Y.—E. E. Blauvelt is now manager of the local branch of the Westchester Telephone Co. in place of Mr. Alexander.

LATROBE, PA.—The Latrobe Telephone Exchange Company has let the contract for the erection and equipment of its plant to the Western Telephone Construction Company of Chicago.

MT. PLEASANT, PA.—The District Telephone Company has announced a further reduction of about 25 per cent. in its rates which took effect on the first of the month.

ROCHESTER. N. Y.—The Standard Telephone Company, at Rochester, N. Y., proposes rates of $3 a month for business houses and $2 a month for residents, which are about half the rates charged by the Bell company in that city.

TOPEKA, KAS.—The Missouri and Kansas Telephone Company recently raised the rate from Troy to Kansas City. The Board of County Commissioners of Doniphan county promptly raised the company's assessment to get even.

IONIA, MICH.—Chase Bros., of Grand Rapids, have asked for a telephone franchise at Ionia and offer to put in instruments for $20 in business places and $15 in residences. Present Bell rates are $35 and $24 respectively.

CLARKSVILLE, TENN.—The Clarksville Telephone Company is engaged in constructing the line from Clarksville to Cumberland City and Erin. Within a few weeks more the line will be ready for use.

WELLS RIVER, VT.—The New England Telephone Co. have bought the Great Northern Telephone plant, put in by E. S. Gray, and will add it to their own line. Wires will soon be changed of the N. E. Company as far as Newport, substituting copper for the present wires.

ALTOONA, PA.—A charter has been granted to the Altoona Phoenix Telephone Company, with a capital of $15,000. H. Price Graffius, A. V. Dively and John Flanigan are the directors. The company may operate in Blair, Huntingdon and Cambria counties.

SANDUSKY, O.—The Sandusky Telephone Co., the new local corporation which has constructed a competing system in this city in opposition to the Bell Company, has begun business with 300 instruments connected with the exchange and something like 100 more yet to be connected.

YOUNGSTOWN, O.—Three hundred subscribers have already been secured for the new Telephone Exchange, and a franchise has been asked of Council. The rates are to be $18 for residences and $35 for business houses, a reduction of 50 per cent. over rates charged by the present exchange.

HOLLIDAYSBURG, PA.—The Phoenix Telephone Company has won a victory in Hollidaysburg. The county commissioners not only decided to place the Phœnix telephones in the offices of prothonotary, register and recorder, sheriff and the commissioners, but also to discontinue the service before furnished by the Bell Company.

NEWARK, O.—The Newark Telephone company has been securing franchises during the month for the construction of a line connecting Newark with Granville, Alexandria, Johnstown and Hartford. The line between Newark and Granville has been in operation for several weeks and the work of extension will soon begin.

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CONTENTS.

ELECTRIC POWER IN NEW YORK CITY.

Last week we commented on the development of electric power in New York State and city, as shown by the census statistics recently published in Washington. Our estimate for the city appears to have been well within the mark. Mr. J. W. Lieb, assistant general manager of the local Edison Electric Illuminating Co. has kindly furnished us with the data from his stations up to October 26, and we can only say that the results are surprising and remarkable. It appears that on January 1, 1895, the company had connected 7,615 H. P. of electric motors, but at the end of last month it had no less than 11,263 H. P., showing an increase of 3,648 H. P. in the short period of ten months. The horsepower capacity thus connected includes, it would seem, a great many of the fan motors, but not all, as it is becoming a common practice for people to plug the small motors into lamp sockets without fuss or notice; and of course, these do not appear on the returns.

The company has 251,487 incandescent lamps connected and 3,280 arcs. This would figure out in the neighborhood of 25,000 H. P.; so that one-third of the company's total connected capacity is now represented by motors. This is a notable showing for power uses of current. We estimated that whereas in the census year, 1890, the motors averaged about 1 H. P. each, they might now reach 5 H. P. Mr. Lieb informs us that the motors average between 5 and 10 H. P., and that one of the motors in regular service on the mains has a rated capacity of 40 H. P. It is evident that the stationary motor industry must be increasing at a rapid rate, for these figures large as they are, take no account of other stations than the Edison and do not include isolated plants, many of which are heavily loaded with motor duty in running pumps, elevators, ventilators and the like.

CURRENT FROM CULM.

We have recently noted some interesting developments in the use of culm for the generation of current, both for immediate local use, as at Wilkesbarre, Pa., where Mr. J. H. Vail is putting up a fine new central station for the Edison service; and in the way of transmission. Dr. Louis Bell, who has given great attention to practical power transmission matters, has an admirable little article in *Cassier's Magazine* for November, on getting long-distance electric power from the coal regions; and places himself squarely on record as believing that the thing can be done, under certain conditions that are very much in evidence in mining regions to-day. With good, average coal, he figures that it is still better to track the energy than to wire it, over, say, a distance of 50 miles. At 15,000 volts the cost of line and apparatus is, he estimates, not less than $100 per kilowatt transmitted. Interest, labor and maintenance at twenty per cent. and assuming 3,000 working hours per year, make the charge for transmission over 0.6 cent per kilowatt hour, which would be prohibitive if translated into a freight rate. But a plant burning culm on a large scale, running 24 hours a day with steady load, can probably put the energy on the line at about 0.3 cent per kilowatt hour; which would enable the delivery, says Dr. Bell, of a mechanical horse power hour anywhere within a radius of 20 miles at an actual cost of one-half to two-

thirds of a cent. Hence the power could be delivered at a margin, below the cost of power to-day, to the average consumer.

But Dr. Bell calls attention to the fact that there is much coal, not culm, that is of very difficult transportation owing to its soft and friable nature, and which often exists in regions where good coal is dear. "In this case, the ability to substitute cheap for costly fuel, is quite sufficient to overcome the cost of even a long electric transmission. It may pay to carry the power even 50 miles or so; and one such case, carefully investigated by the author in some detail, showed that it actually would pay, even with so long a distance to be overcome." One cannot but agree with Dr. Bell that on firm commercial grounds, such transmissions are now in order, and that it is time to shut off the abominable soot and smoke that still pour out in our cities from scores and hundreds of ill managed individual power plants. The manufacture of city fog is a barbaric industry that has not even economical reasons now to justify it.

INVENTIVE INDEPENDENCE.

History has, it is said, and a new instance proves it, an intolerable tendency to repeat itself. Some fifteen or twenty years ago, we were all—that is, those of us then in the field—we were all watching with intense interest, the endeavors of Edison, Sawyer, Weston, Maxim, Swan, Brush and others to create a practical commercial incandescent lamp. The struggle was intense. A golden goal lay ahead, and it was nip and tuck all the way. Jealous as each man was of the others, there can be no question that the successes of any one encouraged and stimulated all the rest in turn, and led on to further effort. At last the prize was reached, and the incandescent lighting art lifted itself suddenly out of the realm of visionary experiment and wild speculation, into that of tangible and concrete engineering and manufacture.

Vacuum tube lighting has now, in the same fashion, it seems to us, reached the point where the solid ground of practicality looms immediately in front. The earnest workers in the field are not few. Some have published their results, others keep silent; but between them all is the subtle interdependence which leads to simultaneous inventions, parallel discoveries, duplicate experiments, needless repetitions, and finally to differing types of apparatus and the choice of separate paths. We publish a letter this week, on page 478, which to those who have been through it all once before, will be a curious reminder of the earlier assertions of independent work and a not less curious augury of the nearness of the new goal. Although sharply challenged, we do not intend to recall what we said, any more than we intended when it was written to imply that the one inventor borrowed from the other. We simply repeat, that the knowledge of other work being done in the same field, must encourage and stimulate all along the line. It is not for us, or anybody else, yet to pronounce which method of giving light without heat is most preferable, most economical, or most original. All one can ask is that these various workers shall be speedy and industrious, for, heaven knows, the art they are seeking to establish is large enough to employ a hundred geniuses; and in the long run each will get his deserts. That Mr. Moore is pursuing his aim with courage, vigor, tenacity of purpose, and remarkable results is apparent to all who know him.

THE MOTORMAN.

Our columns contain this week an able plea for the motorman, which may be said to sum itself up into three heads: higher training, better pay and improved apparatus. The pay must, of course, always depend on the condition of the labor market, but the higher the degree of skill attained by the motorman the more certainly his wages will go up. Many of those who have drifted into the work are like the youth whom we quote elsewhere as seeking an electric railway job because a "phenologist" had told him he possessed a taste for machinery.

One of the remedies applied recently in Brooklyn, as we have noted, is the establishment of a prize fund to be distributed among the motormen who avoid accidents and thus do not inflict loss on the company. This is excellent, but it overlooks in some degree the fact that often the motorman is quite free from blame, even when he does run down a pedestrian. This brings us to the other point mentioned, namely better apparatus, provided with which the motorman would have more chance of piloting his car through the crowded street. The article emphasizes the value of quick acting brakes, which are, indeed, one of the foremost essentials, not only for the men but for the safety of foot passengers and the creation of friendlier relations between the companies and the public. Attention is also called to the palpable fact that the governing mechanism of a car might well be so concentrated and placed as to enable a motorman to sit down if he chooses. Why a street car should be the only vehicle that a man must stand up to drive, is something that no fellow can find out. One of the Chicago newspapers recently showed the motorman there in a nice snug vestibule, warm and cosy, with a dickey bird singing in a cage overhead, and all the comforts of home around him; while the shivering passengers behind him huddled together in a cold car with collars turned up. But even there the passengers were at least sitting down, whereas in some cities, motormen and passengers alike stand up—the one to jerk the hand brake and the others to show that the brake has been jerked.

ACETYLENE PHYSIOLOGICALLY CONSIDERED.

An active and intense interest has been displayed everywhere in regard to acetylene gas, produced from calcium carbide, which is put forward as capable of very cheap manufacture by electricity, in large quantities. We know from the numerous requests we have ourselves received that in lighting circles any information is welcomed as to the proposed new illuminant, so ingeniously made and from which so much is expected. Thus far little has been heard as to the drawbacks and detrimental qualities of the gas, which is but gas after all; and it seems to us that the article from Dr. Birchmore appearing in our pages this week will tend to clear up some of the uncertainty on its physiological effects. It seems also that what Dr. Birchmore reports may be wholly true, and yet leave the gas a valuable addition to modern means of illumination; but the public is very sensitive to the existence of dangers that may lurk unseen in the air around it, and quick to object to any increase in their number. We shall be glad to hear from any of our readers who have made definite observations on acetylene, as to the nature of their results, physiological or otherwise.

Letters to the Editor.

MOORE'S ETHERIC LIGHTING.

On reading your editorial of the 23d inst., on "Etheric Lighting," we were greatly surprised to read,

"Stimulated and encouraged by the results produced by Mr. Tesla in obtaining phosphorescent vacuum tube lighting by means of high potentials and high frequencies, inventors have taken up this work and results are already beginning to manifest themselves."

We feel that this is hardly just to Mr. D. MacFarlan Moore. While we disclaim any intention of disparaging Mr. Tesla's work, we call your attention to the fact that you have unconsciously fallen into error in coupling Mr. Moore's name and Mr. Tesla's.

The public has gotten the impression that Mr. Moore's discoveries and inventions were due primarily to his being "*stimulated by Mr. Tesla.*"

Such is *not* the case. Mr. Moore's interest in phosphorescent lighting dates back a number of years and was never affected by Mr. Tesla's references to the subject.

Some of your readers are aware that there is nothing whatever in common between the widely differing methods employed by each inventor, except that the light is produced by electricity.

Moreover, Mr. Moore was the originator of the term "Etheric" in connection with his lighting system, and long before he had his present laboratory, had written and published a number of articles, intimating in a general way the theory he proposed to employ in producing light with a minimum of heat.

Facts have since demonstrated the correctness of his theory, though originally some of the best electrical authorities pronounced his ideas "impracticable."

The very issue containing your editorial records the fact that nine patents were granted to Mr. Moore on the day named and that many more would follow.

Some of these patents were granted after the Examiner had pronounced the claims non-operative by any known electrical law.

Mr. Moore proved his claims by laboratory demonstration and the patents issued. He was victor at all points.

You have seen Mr. Moore's confidential exhibitions in his laboratory, and in due time we expect you will reproduce the photographs taken at that time, and since, by their own, etheric light, and that you will impart information to your readers which meantime we prefer to keep in abeyance.

We would not trespass on your columns to correct the impression your editorial created, were it not that Mr. Moore's name has been repeatedly coupled with Mr. Tesla's. This was most noticeable at the time Mr. Moore's article on "The Light of the Future" appeared in Cassier's Magazine, July, 1894. The leading journals of the day, although they described only Mr. Moore's work, headed the articles in a way which gave readers the impression that the system referred to was worked out by Mr. Tesla, when in reality he had nothing whatever to do with it. "Honor to whom honor is due."

Moore Electrical Company,
E. J. Wessels,
Vice-President.

Newark, N. J. Oct. 31, 1895.

THE "STANDARD" SOCKET QUESTION.

Now that interest in this question has been awakened, it is to be hoped that it will keep alive and continue to grow until the desired end shall have been attained.

The suggestion offered by one of your correspondents (Mr. Terry) that, this subject be made matter for debate by the next convention of the National E. L. Association is much to be commended.

The same correspondent thinks, however, that the T. H. type of socket—because involving, as he says, a more costly lamp base —should not be considered.

But, if it can be shown that the prevailing assumption, as to the cost of that form of base, is not well founded, i, e., that it does not necessarily cost any more than the others—while, with this form of base, a better socket, scientifically considered, is possible and, at the same time, a less expensive socket—then its claims certainly entitle it to due consideration.

At the conclusion of his amusing recital your other correspondent (Mr. D'Unger) has a paragraph which is, I think, a misinterpretation.

The paragraph in question refers to a letter in a previous issue, from Mr. Rhotehamel.

What Mr. Rhotehamel undoubtedly meant was that, were there but one type of socket, a lesser number of lamps, of the various voltages,—having one style of base only, would be stocked, instead of the larger number, with three styles of base as at present.

And now, touching the general purpose of this question—there are those who say—as is sometimes said of *other* questions—it is one that will "adjust itself."

Such a doctrine, here applied, is, I think, entirely opposed to the spirit of intelligent progress.

Very few things, if any, *do* "adjust themselves"—they have to *be adjusted.*

The genus homo is much like unto the genus "baa, baa." He is very apt indeed blindly to follow, and remain, in the rut in which he first starts, unless, perchance, external agency in some sort be brought to bear to divert him from it.

Invention is of two fold quality. It has its materal *form*—it has its immaterial *essence.* That which complies merely with the one, fails to meet the higher requirements of the other.

The rush of commercial strife tends, too often, to competition merely in *make-shifts*—so it becomes subversive of true progress, and inimical to that higher development and excellence, which delights and satisfies us, by virtue of its obvious fitness—and the evidence it affords of intelligence and intellect underlying the adaptation of end and means.

Alfred Swan.

Nov. 9, 1895.

ELECTRO-MAGNETS AS RELIABLE MECHANISMS.

In The Electrical Engineer of Oct. 30, Mr. James H. Bates makes a statement in a communication relative to electro-magnetic switches in closed electric railway conduits with which we differ. He states "If an electro magnet is the 'most reliable thing in the physical world' why is it not used on each individual car as a cut-out instead of a fuse?"

We would reply to this that railway managers and engineers are awakening to the fact that magnetic circuit breakers are indispensable. The Nantasket Beach Road, the Metropolitan Road in Chicago, the Mt. Holly and Burlington Road, the B. & O. Tunnel electro-motors are all equipped with magnetic circuit breakers of the standard switchboard patterns. The switchboard types are naturally not adapted to this work owing to the blistering and burning of contacts following the opening of the circuit breakers.

The Camden Horse R. R. Co., the Altoona, Pa., Railway, the Pottsville Railway, the Chester, Pa., Railway and others have their cars equipped with the Harrington magnetic car circuit breaker, in which the arcing, followed by blistering and burning of contacts, is effectually overcome by placing a small fuse in shunt to main switch break of circuit breaker.

The use of this fuse shunt protection has resulted in overcoming the objections heretofore raised to the use of magnetic circuit breakers on cars, and the writer knows of at least twenty railways who are now discussing cost of equipping their cars with magnetic circuit breakers, after having gone into the matter of advisability very carefully.

Walter E. Harrington.

Philadelphia, Nov. 4.

Obituary.

LEWIS J. HUTCHINSON.

At Northampton, Mass., on Nov. 4, Supt. Lewis J. Hutchinson of the electric light company was instantly killed at the station. It is probable that he got caught in the shafting, was thrown over a revolving clutch and dashed on the brick floor. The back of his head was crushed, and his arms and ribs broken.

Mr. Hutchinson went to Northampton Sept. 1 to take charge, and was formerly superintendent of construction with the Hawkes Electric Company of Boston. His parents live in Norwich, Vt. He was only 29 years old.

Married.

MONTGOMERY-WATT.

Mr. L. J. Montgomery, secretary of the Electricity Newspaper Company, was married in Jersey City, on Oct. 31, to Miss Mary Helen Watt, youngest daughter of Dr. Thomas Watt, of Kintore, New Brunswick.

KIND WORDS FROM OREGON.

It is pleasant to find in The Electrical Engineer, of New York, for the current week, an article on Portland's long-distance electric-power transmission. The article is handsomely illustrated, and seems to leave nothing to be desired.—*Portland Oregon.*

"These Data Sheets are going to be such a valuable and handy adjunct to The Electrical Engineer that I do not want to miss having even one of them." E. M. Highlands, Clinton, Iowa.

MISCELLANEOUS.

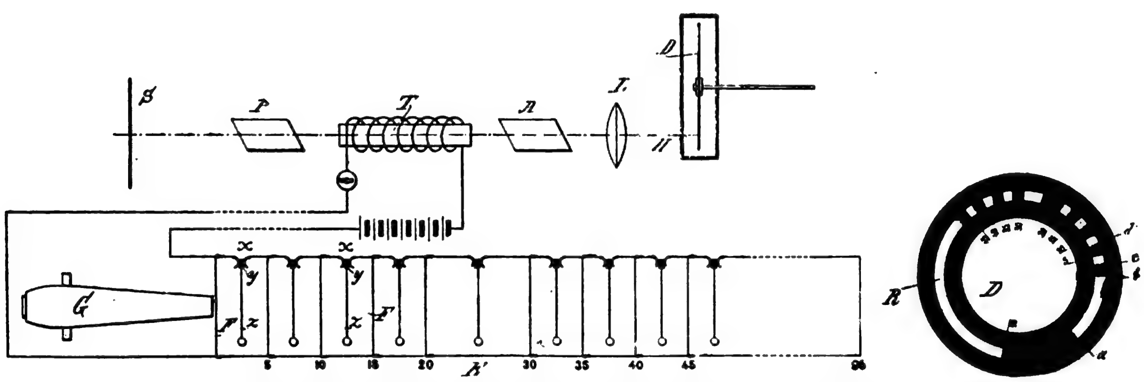
THE CREHORE VELOCITY RECORDER.

In apparatus for the purpose of measuring the velocities of very rapidly moving bodies, such as projectiles, it is, of course, essential that the record shall follow instantly upon the occurrence of the event; but in most such devices now in use it is necessary to put in motion some ponderable object, such as the stylus of a syphon recorder, for instance, thus allowing an appreciable interval to elapse before the record is made, in order that the lines shall be sufficiently clear to enable accurate computations to be made from them.

Mr. Albert C. Crehore, of Hanover, N. H., has, however, recently made public a beautiful device for this purpose, in which a beam of light is the active and imponderable recording agent and the record is made upon a sensitized plate. That the beam may be manipulated without employing a ponderable shutter, Mr. Crehore polarizes it, and by rotating its plane of polarization with the aid of a magnetic field, he produces the interruptions as desired.

This is done by placing a coil about the medium affected by the magnetic field, and creating and withdrawing the field by making and breaking the circuit of the coil. By the proper, uniform, relative movement given to the beam and the sensitized plate, therefore, the exact relation of the makes and breaks in any circuit can be determined and recorded. The meaning of the interruptions in the circuit may be ascertained from the photograph produced; and from the relations between the uniform movement and the reproduced interruptions of the beam of light, results may be computed. Should these interruptions be caused by a moving body, such as a projectile, breaking and making the controlling circuit, its velocity can be accurately determined.

The device will be readily understood by reference to the accompanying illustrations, Figs. 1 and 2, which represent, respectively, a diagram of the apparatus used to measure the velocity of a projectile fired from a gun, and a photograph of the repeatedly interrupted ray of light.



FIGS. 1 AND 2.—CREHORE ELECTRICAL VELOCITY RECORDER.

In Fig. 1 a ray of sunlight passes through an opening in the screen S, and is projected through the Nicol prism P, which acts as a polarizer, the tube of liquid carbon-bisulphide T which possesses the property of rotating the plane of polarization of the beam of light through the action of a magnetic field, the analyzer A and the lens L, by which it is focussed upon a sensitized film supported upon the rotating plate D. This plate is enclosed in a dark box and the light enters through a narrow slit shown at H. The coils which produce the magnetic field about the polarizing agent T are included in the circuit extending along each side of the path of the projectile whose velocity is to be measured. Current is supplied by a battery and controlled by a switch as shown. The gun is shown at G. Cross connections F are placed across the circuit in the path of the projectile at stated intervals. Between each two of these connections is inserted a spring contact x separated by an insulating plug y which hangs a weight attached to a wire z. As the projectile strikes each of these wires it pulls out the insulating plug and re-establishes the circuit.

The operation is as follows: As soon as the current is turned on, its passage through the coil causes light to appear through the analyzer and to persist so long as the current is on. Then upon the firing of the gun the projectile cuts the wire F at the muzzle and so interrupts the current, causing the light through A to vanish completely. When the projectile arrives at z, the plug x will be pulled out, allowing the circuit to be made again and current to flow over the next cross connection F. This makes the light appear again on the plate, to be again suddenly cut off when the projectile cuts the next wire F, and again caused to appear as the projectile pulls the next plug x, and so on, causing a number of makes and breaks in the beam of light and thus recording the intervals between different positions of the projectile. If the photographic plate is revolved, the circle of light produced is interrupted at intervals and by the angle through which the plate turns from one interruption to another the time, and from it the velocity of the projectile, is measured.

Fig. 2 shows the photograph produced upon the revolving plate. The broken ring R represents the reproduction of the intermittent beam of light. The disc D having been started in its rotation and having acquired a uniform rotation of, for instance, twelve or thirteen turns a second, the slide is drawn, at a, the wire F at the muzzle cut by the projectile, at b the first plug drawn, at c the second wire, five feet from the muzzle, cut, at 5, the second plug y drawn, at d, the third wire F, ten feet from the muzzle, cut, at 10, and so on, interrupting the circuit at fifteen, twenty, thirty, thirty-five, forty, forty-five, and ninety-five feet, respectively, from the muzzle of the gun. From the photographic record of the breaks in the circuit, which produces sharp lines, as indicated, the velocity of the projectile during any interval can be accurately determined. By this means the fact may be proved that the velocity of a projectile increases during the first five or ten feet after leaving the muzzle of a gun.

THE CONDENSATION OF FUMES BY STATIC ELECTRICITY.[1]

BY MALVERN W. ILES, SUPERINTENDENT OF THE GLOBE SMELTER, DENVER, COLORADO.

I DESIRE to place on record certain interesting facts, and also a portion of the literature relative to the use of static electricity for the condensation of fog, mist, smoke and fume.

In the *Scientific American Supplement* for June 28, 1884, No. 448, there occurs an article entitled "Dust-free Spaces," which is presumably a fairly correct report of a lecture to the Royal Dublin Society, by Dr. Oliver J. Lodge, April 2, 1884. In this article we learn that Dr. Lodge carried on some very remarkably interesting experiments on the subject of dust, in conjunction with Mr. J. W. Clarke, Demonstrator of Physics in University College, Liverpool. New ideas, new facts are here presented which, in the opinion of the writer, should be carefully studied both by students in metallurgy and electricity. Dr. Lodge uses the following words: "But we (Lodge and Clark) have found another and apparently much more effectual mode of clearing air than this." (Reference being to dust particles collecting upon cold surfaces.) "We do it by discharging electricity into it. It is easily possible to electrify air by means of a point or flame, and an electrified body has this curious property, that the dust near it at once aggregates together into larger particles. It is not difficult to understand why this happens; each of the particles become polarized by induction, and they then cling together end to end, just like iron filings near a magnet. A feeble charge is often sufficient to start this coagulatory action. And when the particles have grown to big ones, they easily and quickly fall." Professor Lodge shows that a fog can readily be turned into a rain; also that jars containing tobacco smoke, or various smokes or fumes, can be quickly and readily transformed into particles of appreciably large size or flocules, and that in this state they settle readily.

Another article appeared in the *Scientific American*, June 27, 1885, upon this subject, entitled: "A New Application of Electricity." In this article we learn that Mr. Alfred O. Walker, one of the partners of the firm of Walker, Parker & Co., at Bagilt, in North Wales, has, in conjunction with Mr. W. M. Hutchins, the manager of the works, applied practically the discoveries of Lodge and Clark, in the condensation of lead fume by static electricity. The writer thinks that directors of mints and superinten-

1. *Columbia School of Mines Quarterly.*

dents of plants handling any volatile metal, would obtain valuable suggestions from the last named article.

B. Rosing, of Tarnowitz, claims to show in July 10th copy of the *Berg-und Huttenmannische Zeitung* that this fact was known in 1850 to Guitard, who showed that tobacco smoke in a glass readily condenses by introducing into the glass one of the wires from an electrical machine. Rosing also cites Wiedemann's work on electricity, *Lehre von der Electricitat*, as referring to this in Vol. I., p. 33.

Through the kindness of the late Francis C. Blake, Superintendent of the Pennsylvania Lead Works at Mansfield, Pa., the writer came into possession of a copy of a patent granted in this country to Alfred O. Walker, on May 25, 1886, No. 342,548, entitled, "Process of Depositing Solid Particles Suspended in Air or Gas."

In a French paper entitled "E. Dieudonné," in *La Lumiere Electrique*, there occurs an article entitled, "The Condensation of Fumes by Static Electricity." This article was translated by the the *Scientific American*, Supplement No. 535, April 3, 1886. There are two drawings in this article which should be highly interesting to all interested in metallurgic fume; likewise, those interested in the smoke question in any of its multitudinous phases.

We understand, that at the Bagilt lead works there was used a modification of the Wimshurst electrical machine. The success of this machine is not known to the writer; neither is the success of the experiments at any place in Europe known to the writer; still, he thinks the subject of the utmost moment, in view of the recent discoveries of Tesla, who, we learn, has transformed current electricity into static electricity.

The writer believes the subject of the volatility of gold, silver, and lead has not received proper and sufficient attention; and many substances, like copper which is classed by the practical metallurgists as being non-volatile, are, indeed, found to suffer at least 6 per cent. loss in fume. This fact I glean from a little pamphlet written by the highest known authority—fifty copies only have ever been published.

With a hope of getting some electricians of prominence interested in this subject in conjunction with the writer, he stated briefly the facts herein-above mentioned to the class at Denver, Colorado, now studying electricity under the organization of the National School of Electricity, at the meeting held May 28, 1895.

If there can be discovered some cheap mode for the generation of static electricity, we predict that it will enable the metallurgist to save a very large amount annually in all the well-known volatile metals.

ELECTRIC SMELTING OF IRON ORE IN THE WEST.

A special dispatch from Duluth, Minn., says:—By a deal just completed at Duluth by O. H. Simmons, who has interested a large number of Eastern capitalists, the consolidation of the Minnesota Canal Company, the Altamonte Canal Company and the Jay Cooke interests has been effected. The Cooke interests own every foot of land for over five miles along the St. Louis River. This water power will be improved and electricity generated, giving a remarkably cheap power, and smelting of iron ore by electricity will begin. There are on the Mesaba and Vermillion ranges hundreds of thousands of tons of low-grade ore, which will never be used until a means is found to smelt it here at home. It is understood that Andrew Carnegie is interested in the new venture, and with him are associated many of the best known iron men of the country. A new range road, to be built by the Merritts, is a part of the general plan.

AMPERE'S BLACKBOARD.

Another "absent-minded man" item has been received. This one refers to Ampere, the famous mathematician who was noted for his absent-mindedness. On one occasion, it is stated that while walking along the street he mistook the back of a cab for a blackboard, and as a blackboard was just the thing he needed at the time, to solve a problem which had been vexing his mind for some moments during his walk, he made use of it. Taking a piece of chalk out of his pocket he proceeded to trace out a number of algebraical formulæ on the cab's back, and followed the moving "board" for the space of a quarter of an hour without noticing the progress of the conveyance. As to whether the cabman charged him by the course or by the hour, or even at all, the item does not inform us.—*Harper's Round Table.*

ELECTRIC WOOD PULP BLEACHING IN MAINE.

The S. D. Warren Co., Westbrook, Me., have purchased a new 100 horse power engine. It is of the horizontal direct connected type. It is to be used in generating current from a dynamo, to be used in electric bleaching of the wood stock.

"I think the DATA SHEETS idea is good a one and will be very well received by all readers of THE ENGINEER." B. V. Swenson, University of Ill., Champaign.

THE MARVIN ELECTRIC POWER TRANSMISSION DRILLS.

The Marvin electric drill, which has recently been placed upon the market by the Marvin Electric Drill Co., of Canastota, N. Y., consists essentially of two coils of wire, placed end for end and surrounding a solid steel plunger which very closely resembles the piston of the steam drill. Electrical impulses are transmitted alternately through these two coils of wire, with the result that the plunger moves to and fro precisely like the piston of a steam engine.

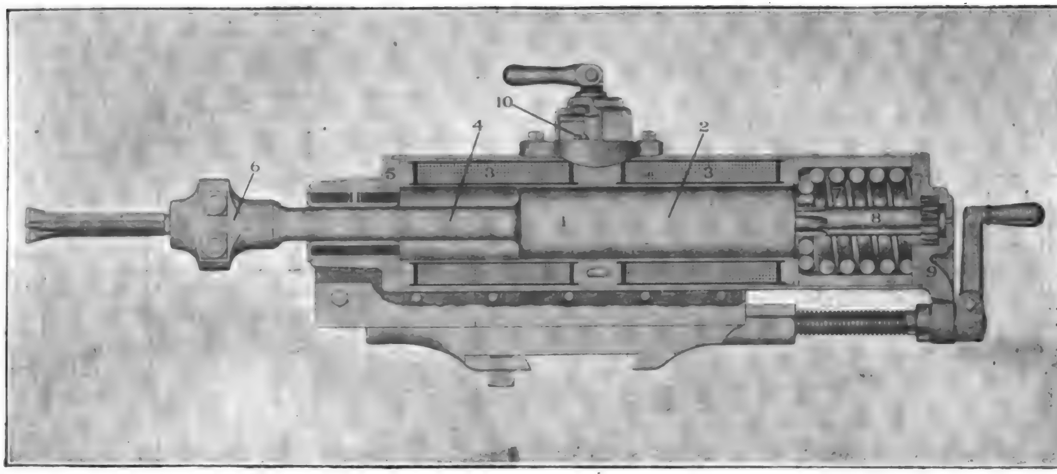
The current is led to the drill from a dynamo of special construction, over three wires, which constitute two independent circuits. There is no commutator upon the drill and nothing resembling a valve, the current being shifted at the dynamo. The coils of the drill are insulated entirely with mica, and hermetically sealed in a boiler tube jacket. The drill is mounted and operated on a column or tripod, in the usual manner. Drills operated on the Marvin system were put in operation in various parts of the country some years ago, but while they afforded striking evidence of the superiority of the electric system, the drills,

THE MARVIN DRILL.

themselves, were not of sufficient capacity and were not built strong enough to fulfill all that was required of them.

The Marvin Co. has been steadily working upon the problem, however, and has finally produced a machine which it believes to afford a satisfactory solution of the problem. About two years ago, a plant of their improved drills was installed at the quarry of the Solvay Process Co., at Syracuse, N. Y. The experience with the drills here has been most satisfactory to the purchaser, and gratifying to the company. The original plant included a dynamo and three drills. The plant has been increased from time to time until now 7 drills are in operation, and it is understood that the number will be shortly increased.

The rock drilled is a hard quality of blue and grey limestone, quite seamy, and on that account somewhat difficult to drill. Two sizes of machines are used, the larger size drilling holes 6 to 8 ft. in depth and 2¼" in diameter, the smaller machine drilling holes about 20" in depth and 1¼" in diameter. The average performance of the large machines is about 60 ft. of hole in 10 hours, although the machine has drilled over 100 ft. in 10 hours. The average performance of the small size drill, which is readily handled by one man, is over 100 ft. of 1¼" hole in 10 hours. The operation of the plant has been uninter-

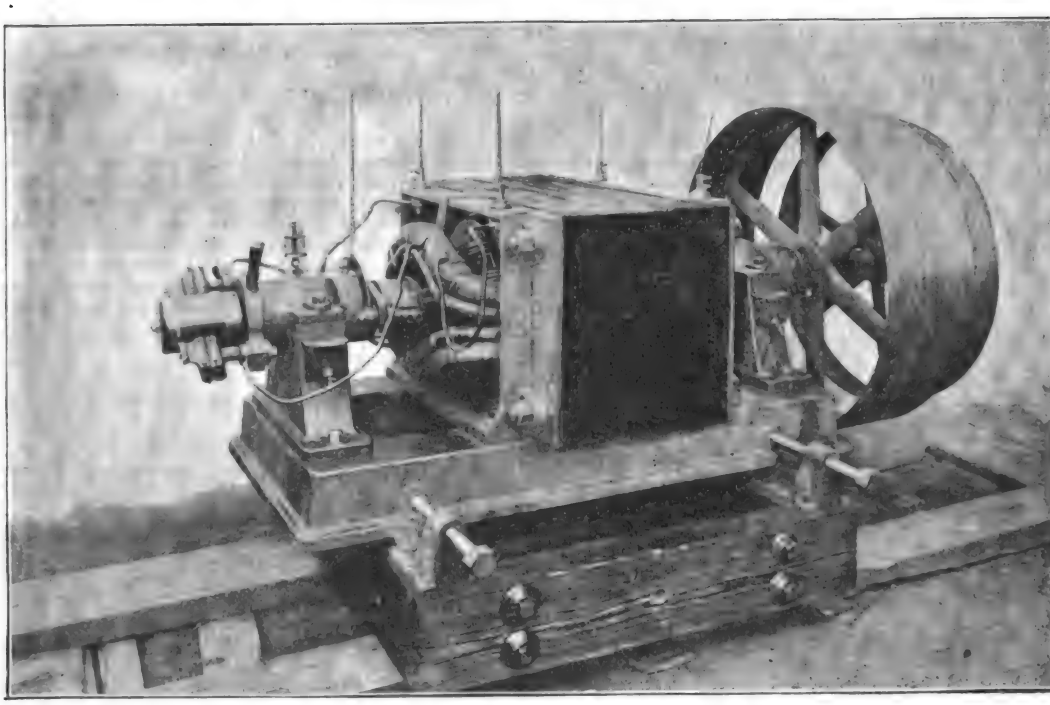


MARVIN DRILL. SECTIONAL VIEW.

rupted since the start, no time having been lost by reason of the failure of any part of the electrical apparatus. No expert help is required in the maintenance of the plant, and it is a significant fact that the drill runners are paid no higher wages than the ordinary quarrymen. The extreme simplicity and strength of construction of the electric drill makes it pre-eminently adapted to mining work. The conditions under which these machines are operated, are entirely hostile to all tight fittings and close adjustments. In the electric drill no such constructions are required. There is, as above stated, nothing resembling a valve motion about the machine. The plunger runs so freely in its bearings, that they are not readily cut out by grit, and in fact, it does no harm if they are very badly worn and loose, as the machine does not lose any of its efficiency or power, under such conditions. The machine may be pounded and banged about, buried in mud and water, exposed to the flying debris of a blast, and in other ways misused, without injury. In operation, the machine is equally plunger is a quarter of an inch or less, but the motion of the plunger continues with the same regularity in speed, as when running with a full 6 or 8 inch stroke. This feature is of great importance in starting a hole and in working through seams. As all of the parts of the drill work very freely, very little oil is used to lubricate the machine.

The dynamo which furnishes the current for the operation of the drills, is characterized by the same simplicity of design and strength of construction employed in the drills. As the dynamo runs in synchronism with the drills, its speed is very low, being from 350 to 400 revolutions per minute, according as it is desired to run the drills with greater or less rapidity.

The winding of the armature consists of a single coil composed of a few turns of stranded wire. Should any accident happen to the machine, the armature winding can be renewed by an ordinary mechanic in a few hours' time, without removing the armature from the dynamo room. Having large self-oiling bear-



MARVIN DYNAMO FOR OPERATING DRILL.

durable. If the drill runner is careless and does not feed the machine up to the rock, no possible injury can result to the drill, as the plunger is automatically cushioned by the electric action, in case the stroke becomes too long. This result is accomplished by the shifting of the current at the dynamo, as the plunger of the drill moves in synchronism with the dynamo armature. This is a point which will be appreciated by all who have had experience with broken front heads and side rods. Another peculiarity of the machine is that its stroke can be shortened indefinitely.

The machine may be fed up to the rock until the stroke of the ings, and requiring no adjustment of the brushes, the dynamo does not require much more attention or expense for maintenance than a Pelton water wheel. Both armature and field of this machine are made up of sheet-iron punching. The field coils are wound upon frames and slid into place in the machine, together with the armature which they surround. The voltage used in this system is 180 volts, alternating, but the pulsations are so slow, about 350 per minute, that little or no shock is received from the wires, and there is no possible danger from contact with any part of the system.

The overheating of the machine which was a troublesome

feature of the former drills, has been entirely overcome, yet the drills are so constructed, being insulated entirely with mica, that an excess of current cannot in any way injure them, as they could be heated red hot without the slightest injury.

Extract from Record of the Marvin Drills at Solvay Process Company's Quarry, at Syracuse, N. Y.

	No. of Drills.	Total Drill Hours.	Total Ft. Cut.	Av. Feet 10 Hours.
1893—January	3	723	4,043	50
April	3	732	4,397	60
July	5	1,340	9,428	60
October	5	993	7,451	75
1894—January	5	1,168	8,225	70
April	5	1,098	7,471	68
July	6	1,369	10,337	75
October	7	1,418	10,241	72
1895—January	5	1,481	11,886	80

DRILL NO. 2.

Total average ft. cut per 10 hours in 1893, by Drill No. 2..............60 ft.
" " " " 1894, " " ....70 ft.
Lineal ft. of 2¼ in. holes cut by drill No. 3, in 1893 and 1894, 32,307. ..6 miles.
Amount of rock excavated in 1893......................................340,000 tons.
" " " " 1894......................................408,000 "
Character of the rock, hard blue and grey limestone.
Extremes of temperature of the air during t me drills have been operated, 110 degrees above, and 10 degrees below zero, Fahrenheit.

THE RATING AND BEHAVIOR OF FUSE WIRES.—II.

W. M. STINE, H. E. GAYTES, AND C. E. FREEMAN.

The results plotted in Fig. 2 are significant. The upper curve was obtained from three-ampere fuses in the covered block. The curve is here more sharply marked than in the case of the same wire blown in an open block. This was found to be true for all sizes of wires tested in this manner, and indicates that a fuse is more sensitive in a covered than in an open block. In this case the shorter distance between the terminals raised the fusing point, and increased its inertia for higher currents.

It was considered desirable to obtain data which should exhibit the action of the fuse with the cooling effect of the terminals eliminated. To accomplish this, the fuses were blown in lengths of eight inches, with asbestos supports placed each inch of length, the block in all cases being horizontal. The supports practically prevented the breaking of the fuse from hydrostatic pressure. The results with A. and B. wires, and the German silver (18 per cent.), as well, are shown in Figs. 3–6. It was supposed, though such curves are hyperbolic, that for abnormally high currents they would exhibit somewhat constant inertia times, due to the oxide coating and other mechanical causes. The results clearly confirmed this, the inertia time constant in some cases amounting to two seconds.

The blowing of the fuse is not immediately an electrical act. The current fuses the metal, the cross-section is reduced at some point due to gravity, unequal expansion, or "sweating"; the heat in consequence intensifies at this point, and a globule falls, breaking the circuit and establishing an arc, which soon burns out a length of the fuse. This accounts for the sluggish action of such thermal cut-outs. An ideal fuse would be one that would act at approximately a constant time interval for all currents in excess of its normal. It would, in this respect, closely resemble the action of an electro-magnetic cut-out. Its curve would be a straight line extending from its normal point, and slightly approaching the vertical axis for all abnormal currents, being thus identical with the curve of the electro-magnetic cut-outs. In practice the curves of all thermal cut-outs must be more or less modified hyperbolas. The ideal curve could only be attained were it possible to eliminate conduction and radiation losses.

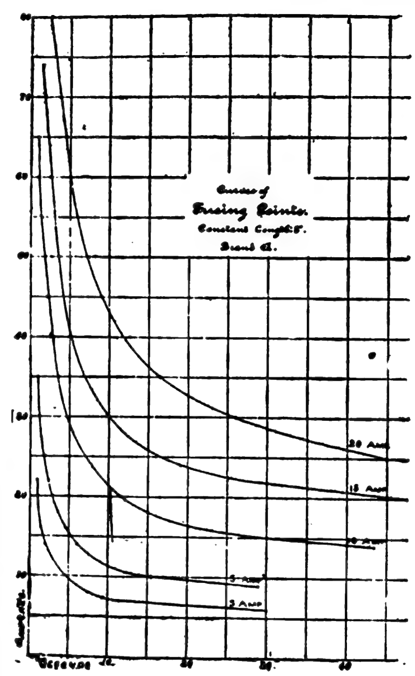


FIG. 3.

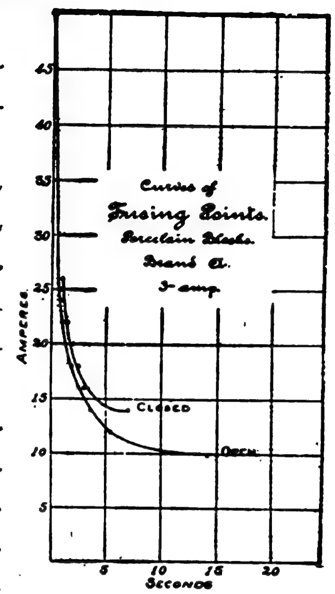
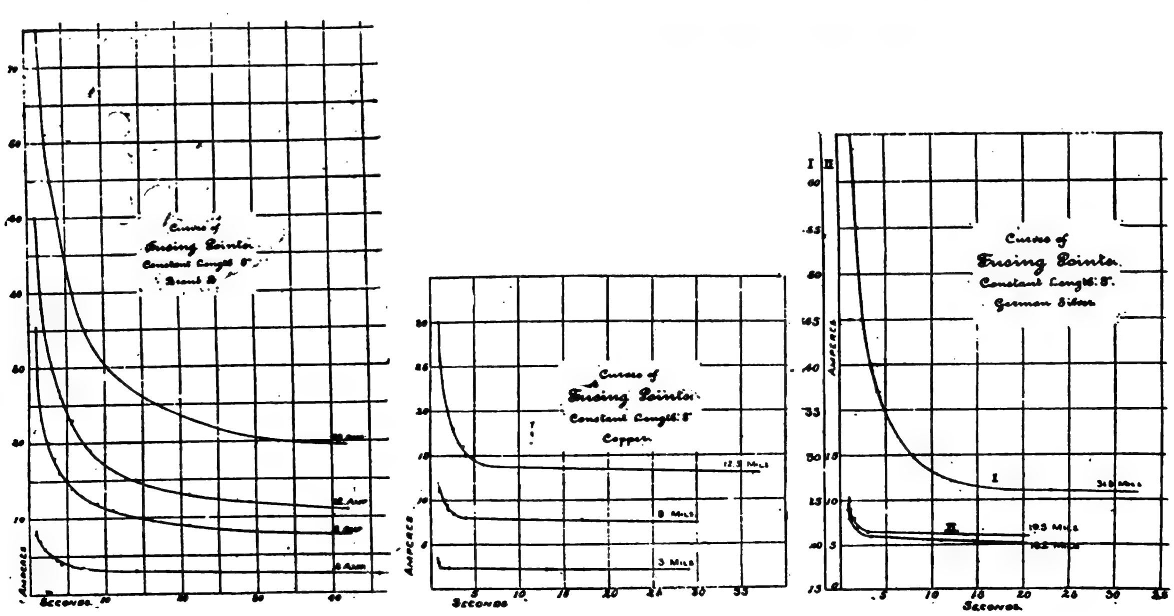


FIG. 2.

This is evidently the line to follow in designing a sensitive fusing block.

The curves in Figs. 3 and 4 clearly exhibit the relative sensitiveness of small and large fuse wires; the smaller diameters approach more nearly the ideal condition. This is of great practical interest in guarding against excessive currents of short duration, such as motors are subject to when operated from street railway and power circuits. In such cases a multiple fuse of four pieces of five-ampere wire would prove from two to three times as sensitive as one piece of 20-ampere size. Such multiple fuses have been found by the writer to prevent effectually the belt slipping off the pulley of small dynamos under short circuits. The sluggishness of large fuse wires may be due to the cooling of



FIGS. 4, 5 AND 6.—RATING AND BEHAVIOR OF FUSE WIRES.

the outer layers, which, with the oxide coating, prevent the fuse from breaking. It is evident that this effect would be less in small wires. For this reason a thin ribbon should prove more sensitive than a round wire.

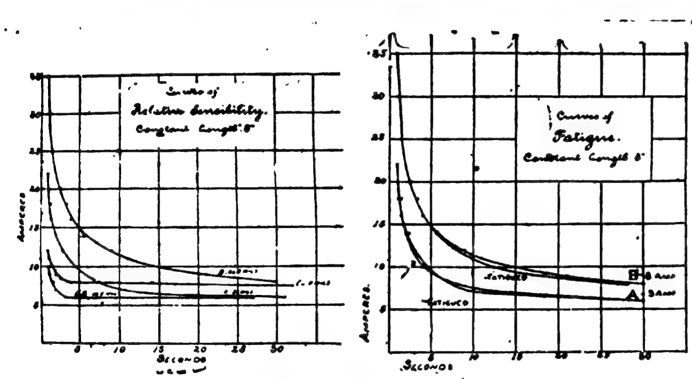
These tests with long lengths of wire reveal some actions which may account for the lowering of the fusing point by use. In the A wires, with a current just below the fusing value, the wires were found to "sweat"; the oxide film broke in places and allowed the molten interior to ooze out. When the current was shut off the globules were drawn in, leaving the wire pitted. With the B fuses the metal was found to be remarkably plastic and free from the oxide film. These fuses sagged badly and twisted, showing a high coefficient of expansion. As a result they were drawn out and the cross-section reduced.

When used vertically, the metal flowed until a large globule formed, the rupture occurring just above this. In the case of the German silver fuses the sweating resulted in partially breaking up the alloy, the zinc seeming to melt out from the nickel and fusing with the copper, formed globules of brass. This was so marked that it would render such fuses too uncertain for use in all but the smallest diameters of wire.

A comparison of the 8-ampere curves in Figs. 2 and 3 shows the effect of shortening the fuse. The blowing current for 15 seconds of 6.8 amperes in the case of the short fuse in the open porcelain block, was raised to 10 amperes. Excepting the higher fusing points, the curve of the long fuse is the same as that for the shorter length. It is evident from such data that the usual rating of fuse wires in ampere carrying capacity is practically valueless, and should be discontinued. The proper designation for such wires would be a table of carrying capacities for the lengths ordinarily employed.

The 10-ampere wire of Fig. 8 fused in 30 seconds at 15 amperes in an eight inch length; in a length of one-half inch in a covered block at 35 amperes, and in the open block, length seven-eighth inch, at 25 amperes. Accompanying each spool of the B wire was a stated carrying capacity for a given length, but this is not sufficient, since it furnishes no guide for other lengths.

Copper fuses have frequently been stated to be more prompt in action than the alloys usually employed. Compare the curve of the 12.5 mil copper wire (Fig. 5) with that of the 12-ampere wire in Fig. 4, and the increased sensibility of the copper fuse is apparent. The plastic condition of the ordinary fuse alloys extends through a proportionately greater temperature range than the copper, resulting in a rounded curve. The copper fuses reached red and even white heat in these tests, while the other fuse wires scarcely reached a perceptible glow. This has a practical significance in selecting metals for fuse wires. Metals in general, which can be worked at or near a white heat, will prove most sensitive, since a slight increase of heat will make them highly fluid, and rupture will promptly occur. The practice of



FIGS. 7 AND 8.

using copper in street railway circuits for limit fuses seems justifiable. Whether the oxide film of copper fuses would prove progressive in formation is a question which has not been definitely settled. A 8 mil copper wire, which fused at 2.2 amperes in 13 seconds, was fatigued at a red heat for eight minutes; cooled and tested under the first condition, it fused at 2.2 amperes in 14 seconds.

The A fuses, cut from the ordinary lead-tin fuse wire, only worked at a bright red heat in very short lengths, such as ½ inch. This undoubtedly influenced the sharpness of the curve for the closed block in Fig. 2, and is a fact that seems to possess some practical importance. Our tests in general showed the desirability of working fuses at a red heat for normal maximum loads. But this is a question which must be eventually left with the underwriters.

Fig. 7 gives the relative sensibility for the different fuse metals tested, and the copper curve is clearly the best. German silver acts well in these wires, but for the larger sizes (Fig. 6) it offers no advantages, and deteriorates more rapidly than any wire tested. It is now in general use on telephone and similar circuits. The wire is about four inches in length and inclosed in a fibre tube. A number of such fuses, obtained from the Chicago Telephone Company, were tested. They were rated for a carrying capacity of five amperes and fused in all cases within six amperes. A slight variation in fusing was no doubt due to the cooling effect of the tube in contact with the wire. Some such device as this, with copper wire for the fuse, would be most excellent for electric lighting and power circuits.

It was thought best to study the influence of "fatigue" on a wire. A special board was prepared with two rows of insulated pins placed ten inches apart. A length of fuse wire was threaded back and forth over these, the wire being supported out of contact with the board. A current, just short of the fusing strength, was passed for seven hours. The results are plotted in Fig. 8. It will be noticed that the A fuses experienced a positive fatigue, the B wire a negative one. This is of importance in practice, and shows the superiority of the B wire, whose fusing point was

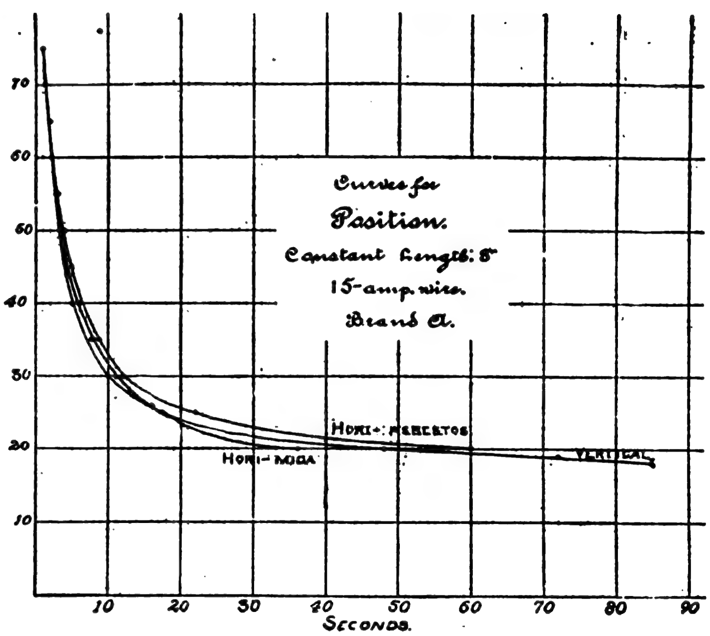


FIG. 9.

lowered while the other was raised, due to a diminution of cross-section and absence of oxide film.

A great deal has been said about the influence of grease films on lead fuses. This point was also investigated. The grease was removed from the wires by immersion in KOH and NaOH with subsequent washing. In other cases the wire was cleaned by the use of fine sand-paper. The oxide film was also removed by immersion in nitric acid. Measurements showed that this treatment did not sensibly reduce the cross-section. When the oxide film was removed by either mechanical or chemical means it was noticed that a thicker coating formed at once, raising the fusing point. In short, these tests showed that nothing was gained by cleaning the wires, but that the thin film of grease deposited during the drawing of the wire was rather an advantage. The wires were also coated with shellac, but without encouraging results. Some coating, not affected by heat, and which would reduce the radiation, would doubtless increase the stability and sensibility of fuse wire.

For the following tests an adjustable fuse block was constructed on which the fuse was held about one inch above the base and supported each inch by either thin asbestos or mica supports. In order to ascertain the influence of these supports, tests plotted in Fig. 9 were made. The influence of hydrostatic pressure is shown by the horizontal curve with the asbestos supports being higher than the vertical curve. The curve with mica supports is lower for the reason that the mica cut the softened wire.

A singular phenomenon was noticed with the A fuses blown horizontally in the eight-inch block. The arc would usually occur at about the same place near the centre of the fuse, and when the time was within six seconds, the entire fuse was shattered into approximately equal lengths, varying from ⅛ inch to ¼ inch, depending upon the current employed. The length of these pieces varied inversely with the current strength. The uniformity of these results was noticeable throughout all our tests. The entire fuse, to within a short distance of the terminal, seemed to explode into fragments simultaneously with the formation of the arc. This rhythmic action has been pointed out by the author for copper wire fused by lightning.[3] The ends of such pieces invari-

3. *Electrical Engineer*, July 13, 1895, p. 38.

ably showed a crystalline structure, indicating that the entire fuse was melted, and prevented from flowing by the oxide film.

Reports of Companies.

BAGNALL & HILLES.

Albert L. Bagnall and Ladonis D. Hilles, who composed the firm of Bagnall & Hilles, dealers in electrical supplies at No. 15 Cortlandt Street, with a branch at Yokohama, Japan, have made an assignment for the benefit of creditors to James W. Godfrey.

PORT RICHMOND & PROHIBITION PARK RAILROAD.

Judgment for $84,174 has been entered against the Port Richmond and Prohibition Park Electric Railroad Company of Staten Island in favor of Ernest Hall as receiver of the firm of J. C. Thompson & Co., for money loaned from Aug. 7, 1892, to Feb. 26, 1895.

MORE TROUBLE FOR THE STANDARD.

It is now reported that the New Jersey Standard Telephone Co. has appointed a committee to investigate the parent New York Company, it having, it is said, paid $20,000 for rights in New Jersey and Delaware without receiving so far any return in the shape of apparatus or facilities.

STORAGE BATTERY ACTIVITY.

Regarding the recent flurry in the securities of the Electric Storage Battery Company, W. W. Gibbs, its president, says that the decline was unwarranted. "The business of the company is growing rapidly," he added; "current receipts are constantly increasing and numerous extremely important installations are in process of consummation. No business is upon a more substantial basis to-day than the storage battery business. While litigation has delayed the exploitation of that industry in this country until six months ago, when we obtained control of all the patents, the enormous business and large profits secured by the storage battery companies in Germany, France and England give an earnest of what is awaiting us here. We have installed a large number of extremely important plants, one factory is working full time and a very large extension to it is now in progress."

Legal Notes.

THE AMERICAN BELL MOTION TO DISMISS THE BERLINER CASE DENIED BY THE SUPREME COURT.

At Washington, on Nov. 11, the United States Supreme Court denied the motion made recently by the American Bell Telephone Co. to dismiss the appeal of the United States Government in the case involving the validity of the Berliner microphone patent. The Supreme Court holds that it has full jurisdiction in the matter to try the case.

THE BRADLEY DECISION AGAINST THE SAWYER-MAN LAMP PATENT SUSTAINED BY THE U. S. SUPREME COURT.

IN THE SUPREME COURT OF THE UNITED STATES.—CONSOLIDATED ELECTRIC LIGHT CO. VS. MCKEESPORT ELECTRIC CO.

We give below the text of the long expected decision of the U. S. Supreme Court in the "McKeesport" case. The Court, as will be seen, sustains Justice Bradley in refusing to find against Edison for infringement, under the Sawyer-Man fibrous carbon patent. The Supreme Court decision leaves the lamp situation practically where it was. The broad patent of Edison, as well as that of Sawyer and Man, are now both open to the public. The remaining patents of importance relating to incandescent lamps are those which cover the process of manufacture whereby filaments are rendered of uniform resistance by hydrocarbon treatment. These patents, which are owned by the Westinghouse Company, have not yet been litigated. The Westinghouse Company also owns the Weston group of patents covering the use of tamidine or cellulose as a material for making filaments, and claims to control by a separate patent of Stanley the use of silk as a base for filaments.

The patent with regard to which Judge Bradley's rather emphatic decision in favor of Edison was given, bears date May 12, 1885, and was filed Jan. 9, 1880. Its claims are given below:

"1. An incandescing conductor for an electric lamp of carbonized fibrous or textile material, and of an arch or horseshoe shape, substantially as hereinbefore set forth."

"2. The combination, substantially as hereinbefore set forth, of an electric circuit and an incandescing conductor, of carbonised fibrous material, included in and forming part of said circuit, and a transparent hermetically-sealed chamber in which the conductor is enclosed."

"3. The incandescing conductor for an electric lamp, formed of carbonised paper, substantially as described."

"4 An incandescing electric lamp consisting of the following elements in combination: first, an illuminating chamber made wholly of glass hermetically sealed, and out of which all carbon-consuming gas has been exhausted or driven; second, an electric-circuit conductor passing through the glass wall of said chamber, and hermetically sealed therein, as described; third, an illuminating conductor in said circuit, and forming part thereof, within said chamber, consisting of carbon made from fibrous or textile material, having the form of an arch or loop, substantially as described, for the purpose specified."

As will be noted, the patent had a long term in the Patent Office before issuance; but it was speedily put to a test thereafter. The case before Justice Bradley was that of the Consolidated Electric Light Co. against the McKeesport Light Co. (an Edison licensee) and came up in the May term of 1888, of the U. S. Circuit Court for the Western District of Pennsylvania. In his decision given Oct. 5, 1889, Judge Bradley held, in effect, that while Sawyer and Man had not made a finally successful lamp, Edison had, by hitting upon the principle of a high resistance, small diameter filament, "which was really the grand discovery * * * without which it could not have become a practical art." Moreover, the Sawyer-Man patent he held had been in the original application meant to apply to a "carbon arch" rather than to the broad use of the fibrous carbon filament.

Opinion by Mr. Justice Brown, November 11th, 1895.

This is known as the "Incandescent Light" case. It was a petition to recover damages for the infringement of certain letters patent issued to Sawyer and Man and the defendants justified under certain patents to Edison from whom the defendant is lessee. The cause involves the difference between what are known as the Sawyer and Man and the Edison systems of incandescent lighting.

On the hearing in the court below the court held, in the first place, that the patent was invalid upon its face by reason of the amendments that were made to the original application, making it practically a new application and within the rules regarding re-issues of letters-patent; and held the patent to be defective upon the ground that the question of priority of invention as between Sawyer and Man and Edison was with Mr. Edison and that the experiments of Sawyer and Man never resulted in a satisfactory working apparatus.

We have only considered the first. We have not deemed it necessary to dispose of the question of fact, which was so elaborately argued upon both sides, as to which party was entitled to be considered the inventor of the system. The main question upon which we dispose of the case is the validity of the patent itself, which was for vegetable fibre as distinguished from mineral which had been theretofore mostly used for the purpose of incandescent lighting. The difficulty with these claims is that we think they are too broad; that if there were some general quality running through all fibres of vegetable materials which rendered them adapted to the purposes of incandescent lighting the patent might be sustained, but as a matter of fact the only material which seems to have been experimented upon by Sawyer and Man was carbonized paper and wood charcoal. On the other hand very careful experiments were made by Mr. Edison and his assistants and some six thousand vegetable substances were examined for the purpose of finding the best material for an incandescent conductor and it was settled upon that a certain species of bamboo, the cuticle of bamboo, which was the part that was used, the useful part being only $\frac{10}{1000}$ of an inch in thickness fulfilled better than any other material the requirements of an incandescent conductor. It appears that the material used by Sawyer and Man is now no longer used and that they use bamboo for an incandescent conductor. In other words, they have adopted the material used by Edison.

It is claimed that their patent is broad enough to include the material used by Mr. Edison and, therefore, that the difference in material is immaterial. We think, however, that while the claim for carbonized paper might have been consistent with the claim for all fibrous or textile materials, yet under the decisions of this court which have held that claims must be specific enough to enlighten persons as to how the machine can be made or used, we think there is nothing by which persons could be informed of the proper materials that could be used. We think that Sawyer and Man had no right to shut off further investigation in the line of fibrous materials and whether that patent would be on its face

sufficient to protect them in the use of carbonized paper to which the third claim is confined, we think that the other claims are too broad to sustain the patent; and as this practically disposes of the case adversely we have not thought it necessary to consider the other questions. The decree of the court below is, therefore, affirmed.

CHICAGO METROPOLITAN RAILWAY COMPANY ANSWERS THE SIEMENS & HALSKE COMPLAINT.

THE Metropolitan Elevated railroad company of Chicago has filed in the United States Circuit Court there an answer to the bill entered against the company by the Siemens & Halske company some time ago in which certain electric railway patents are involved, concerning the third rail and other features.

The defendant asserts that the patent of Ernst Werner Siemens, taken out Aug. 17, 1885, was preceded by others years before. In the voluminous answer of the Metropolitan company 165 patents are quoted with the date and name as having priority over that of Siemens.

SIEMENS-HALSKE ARC LAMP LITIGATION.

The patents involved in the suits brought by the Siemens & Halske Electric Co. against the General Incandescent Arc Light Co. on chain feed and twin arc lamps are Nos. 412,141, 498,566 and 518,719. The types named are in extensive use in New York and many other cities.

THE WESTERN ELECTRIC Co. has sued the Capital Telephone Co., of Sacramento, Cal., for infringement of patents on telephonic switching and apparatus.

SOCIETY AND CLUB NOTES.

MESSRS. ARTHUR WILLIAMS, general inspector of the Edison Electric Illuminating Co., New York, and Douglas Burnett, instructor in physics, Pratt Institute, Brooklyn, gave an illustrated lecture at the Bedford branch of the Y. M. C. A., Brooklyn, on election night, upon the general subject of electricity, with many illustrations.

BROOKLYN INSTITUTE OF ARTS AND SCIENCES.

On Nov. 4, Prof. W. A. Anthony lectured before the Department of Electricity of the Brooklyn Institute on "Systems of Electrical Distribution," his lecture being devoted to an interesting analysis of and contrast between the series and the multiple way of doing things. The lecture was illustrated.

"PERMANENT ADVERTISING."

"Enclosed please find check for sixty cents for which please send one of your Morocco filing cases for THE ELECTRICAL ENGINEER Data Sheets. We should also be pleased to know what rate you charge for advertising on the back of these sheets. We think it a splendid idea if it is only kept up." The Emerson Electric Mfg. Co., C. R. Meston, Secy.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED NOV. 5, 1895.

Alarms and Signals:—

Tower Strike, T. R. Mercein and E. R. Porter, Milwaukee, Wis., 549,205. Filed Mch. 23, 1895.

Consists of a bell operated by balls adapted to run through a passage by gravity and strike against the bell at the lower end of the passage; the movement of the ball being controlled by an electromagnetic device.

Electrical Annunciator, R. L. Hunter, Minneapolis, Minn., 549,240. Filed Dec. 11, 1893.

Electrical Annunciator, R. L. Hunter, Minneapolis, Minn., 549,241. Filed Feb. 3, 1894.

Transmitting Time Signals, C. E. Buell, North Plainfield, N. J., 549,346. Filed May 27, 1895.

Conductors, Conduits and Insulators:—

Method of Making Insulator Rings, C. F. Peterson, Schenectady, N. Y., 549,254. Filed June 1, 1895.

Has for its object to simplify the construction of mica insulator rings.

Method of Lining Tubes or Cylinders, J. H. R. Ward, Stoughton, Mass., and C. A. Noll, New York, 549,342. Filed Aug. 15, 1895.

The method consists in placing in the tube or cylinder a liquid holding solid matter in suspension, and rapidly rotating the tube.

Insulating Rails, F. W. Wilson, New York, 549,416. Filed June 22, 1895.

Employs an insulating base plate and insulating side pieces, all being held in place by the clamps which secure the rail to the tie.

Electric Supporting Insulator, J. Collins, Washington, D. C., 549,443. Filed Sept. 23, 1895.

An insulator quadrangular in cross section.

Distribution:—

System of Electrical Distribution, W. MacN. Fairfax, Brooklyn, N. Y., 549,189. Filed Feb. 7, 1893.

The method consists in supplying current to a number of groups of devices in succession and maintaining the potential constant in each group by generating a counter-electromotive-force in derivation to each group.

Dynamos and Motors:—

Controlling Electric Motors, W. B. Potter, Schenectady, N. Y., 549,158, Filed Aug. 8, 1895.

The method consists in connecting the two motors running on a three-wire system between an outside main and the neutral, shunting one of the motors and then connecting them between the two outside mains, preserving the connection to the neutral between the two motors.

Armature for Dynamo Electric Machines or Motors, W. Decker, Owego, N. Y., 549,234. Filed Nov. 17, 1893.

The system consists in winding two groups of coils each having an equal number of coils on the armature core, the coils of one group differing from those in the other only in length along their axial line

Electrical Dental Engine, F. O. Priestly, Denver, Colo., 549,464. Filed Feb. 12, 1895.

Lamps and Appurtenances:—

Electric Arc Lamp, F. Jehl, Vienna, Austria-Hungary, 549,182. Filed May 12, 1894.

Claim 1 follows: The combination with a carbon electrode of an arc lamp, of a quiescent or stagnant gaseous envelope surrounding and extending along said carbon to the point or face from which the arc emanates.

Electric Arc Lamp, C. F. Vogelius, Bloomfield, N. J., 549,409. Filed Jan. 17, 1895.

Relates to a device for excluding air from the globe of the lamps.

Incandescent Lamp Reflector, C. J. Klein, New York, 549,201. Filed Apl. 18, 1895.

A shade or reflector having near one end an engaging means for the neck of the lamp and near the other end a perforated spring for receiving the teat of the lamp, the said spring being curved inwardly toward the centre of the reflector and the edge of the reflector extending beyond the spring, whereby the entire illuminating power of the lamp is made available for concentration upon a particular spot by the reflector.

Measurement:—

Electric Meter, R. O. Hood, Danvers, Mass., 549,195. Filed March 9, 1895.

Consists of a coil in the circuit to be measured, a movable mass acted upon by the dynamic action of the coil, and intermittently acting device for retarding the movement of the mass and a device for recording this movement.

Miscellaneous:—

Electrolytic Apparatus, T. Craney, Bay City, Mich., 549,186. Filed March 16, 1893

Apparatus for Freeing Water from Scale Producing Impurities, S. G. Cabell, Washington, D. C., 549,435. Filed Nov. 30, 1894.

Provides means for destroying the scale-producing impurities in water by subjecting the latter to galvanic action before allowing it to enter the boiler.

Apparatus for Purifying Water by Galvanic Action, S. G. Cabell, Washington, D. C. 549,436. Filed Feb. 15, 1895.

Similar to No. 549,435.

Apparatus for Indicating Difference of Phase, M. Von Dolivo-Dobrowolsky, Berlin, Germany, 549,449. Filed April 20, 1895.

Has for its object to indicate any lag or advance between the phase of an alternating current and that of the electromotive force of the same current, and to enable this difference in phase to be automatically corrected.

Brake for Electric or Other Cars, E. S. Amrock, Waltham, Mass., 549,094. Filed Mch. 16, 1893.

Improvement in hydrostatic brakes.

Electric Heater for Curling Irons, G. D. Pogue, Jerseyville, Ill., 549,152. Filed Dec. 22, 1894.

Arrangement by which placing tongs in heater closes circuit.

Railways and Appliances:—

Street-Car Lighting, F. E. Kinsman, Plainfield, N. J., 549,136. Filed Feb. 27, 1895.

Provides for the accidental disconnection of the branch circuit from the trolley wire which supplies current to the lamps, by employing a storage battery and automatic means for throwing it in circuit in case of the trolley leaving the wire.

Switches, Cut-Outs, etc.:—

Electric Switch, J. B. Smith & A. L. Clough, Manchester, N. H., 549,162. Filed April 26, 1895.

An automatic cut-out switch for motors.

Electromagnetic Switch, C. L. Penny, Newark, Del., 549,209. Filed March 12, 1895.

Electric Switch, G. W. Hart, Hartford, Conn., 549,237. Filed March 19, 1895.

A flush switch for incandescent circuits.

Arc Cut-Out, C. D. Haskins, Newton, Mass., 549,268. Filed March 6, 1895.

Employs a toggle lever forming part of the main circuit and having contact members arranged to break contact with each other after they have engaged the line terminals.

Automatic Regulator for Converters of Energy, W. E. Moore, Augusta, Ga., 549,388. Filed Mch. 20, 1895.

Has for its object to provide a load indicator with circuit opening and closing devices arranged to be thrown in multiple successively when the load is increasing, and to be disconnected when the load is decreasing

Carbon Contact Resistance Switch, F. G. H. Meyer, Charlottenburg, Germany, 549,456. Filed April 4, 1894.

Electrical Resistance, H. E. Werline, Lancaster, Pa., 549,470. Filed Dec. 28, 1895. (Error as to date, see Patent Gazette.)

Employs lapping filaments connected to form a continuous conductor; the resistance of one part of this conductor varying in a direction opposite to that of another part under changes of temperature, and non-conducting walls between the filaments.

Railway Switch, E. C. Howe, Hartford, Conn, 549,129. Filed Sept. 11, 1895.

A railway switch consisting of a bed with tread sections of magnetic metal, cores of magnetic metal joined to the tread sections, coils of wire connected with an electric circuit placed upon the cores, and an armature tongue of magnetic metal movable between the treads.

Telegraphs:—

Printing Telegraph System, J. E. Woodbridge, Duluth, Minn., 549,179. Filed Jan. 29, 1895.

Telephones and Apparatus:—

Local Transmitter-Circuit for Telephones, W. W. Dean, St. Louis, Mo., 549,477. Filed Mch. 29, 1895.

Employs two microphones connected with a common diaphragm so that as one increases the resistance through its circuit the other decreases the resistance through its circuit, the two microphones always acting in opposite directions.

Telephone, S. Alexander, Hartford, Conn., 549,304. Filed Sept. 24, 1895.

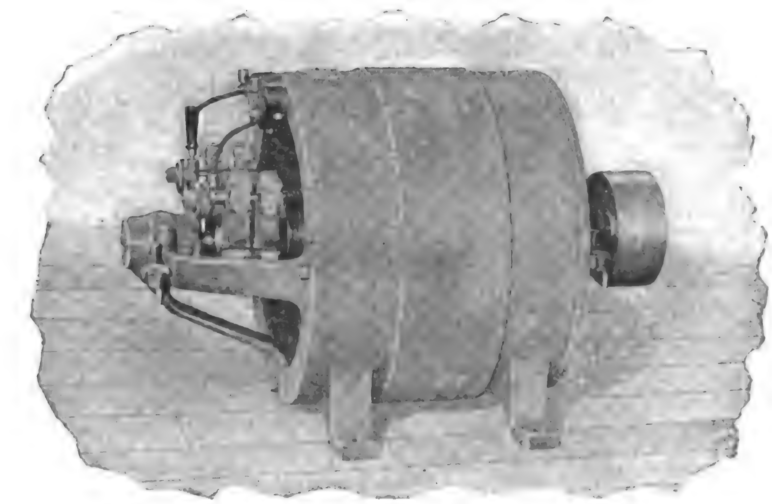
Modification of transmitter sounding case and post.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

G. E. IRONCLAD GENERATORS AND STATIONARY MOTORS.

The list of slow and moderate speed four-pole dynamos and motors of the General Electric Company has been supplemented by a series of machines adapted to smaller output than is practicable with the four-pole type. They are classed under the head "I. B." from the fact of having an ironclad bipolar frame, and are built for various outputs—from ¾ to 4½ kilowatts as generators and from 1 to 5 horse power as motors. The frames are cylindrical and are supported on short legs. This brings the centre of gravity very low and conduces to stability and steadiness when running. The space occupied by the machine is small for its output, and its shape and construction allows of its use in positions where machines of the ordinary bipolar type could not well be placed. The armature has a toothed core with the conductors embedded in the slots. Ample cross section has been



NEW G. E. IRONCLAD GENERATOR AND MOTOR.

allowed the copper in the field and armature windings, and the insulation is high. The brush holders are designed to hold the brushes firmly and evenly upon the commutator, adjusting themselves readily to the wear of commutator and brush, preserving under all conditions a good contact without excessive friction.

The speeds are comparatively low, varying from 1,800 to 1,000 revolutions per minute according to the size of the machines.

A large number of these I. B. motors are already in use. The generators are successfully used in isolated plants and in cases where a small amount of current economically generated is desired.

NEW FORT WAYNE CORPORATION CATALOGUE.

THE Fort Wayne Electric Corporation of Fort Wayne, Ind., have recently issued a new and most complete catalogue of the Wood systems of electrical machinery, and the various other electrical apparatus manufactured by that well known and enterprising concern. The front cover is of very handsome design, showing in comparison their old and recent makes of machines, and an ornamental arc lamp, and also the title of the catalogue illustrated in color and stamped out in bold relief. On the back of the cover, the monogram of the corporation is printed in the same style. It is a superb piece of work.

The catalogue contains 182 pages of printed matter, and has a large number of illustrations showing the different kinds of electric lighting and power apparatus, and the numerous other electrical devices turned out by this concern. The descriptive matter is very lucid, and so worded that non-technical people should be able to comprehend it quite easily.

The catalogue is compiled and brought out under the supervision of Mr. Jas. J. Wood, the electrician and general superintendent of the concern, who is to be congratulated on the thorough and tasteful manner in which the work has been done.

SCHUYLER PURCHASE BY THE GENERAL ELECTRIC CO.

The Schuyler electric factory of Middletown has been sold at public auction to the General Electric Company for $73,000 and all patents and patents applied for, belonging to the Schuyler Company, were sold to the General Electric for $40,000.

THE PARKER ENGINEERING CO.

An important change has recently been made in the personnel of the engineering firm of J. W. Parker & Co. of 35 North Seventh street. The following is the text of the circular of the new concern, issued by Mr. Parker, as manager.

On and after the above date the Firm of J. W. Parker & Co., will be succeeded by the undersigned, will change its personnel and style and will be known as The Parker Engineering Co. (not Inc.) and will occupy the above numbered large and commodious building.

Mr. James H. McBrier of the Ball Engine Co., of Erie, becoming the active head and Mr Parker of the old firm being retained as Manager.

Its line of goods will be as follows: General Agents for The Ball Engine Co., of Erie, Pa.; The New Britain Machine Co. (Builders of the Case Automatic Engine), The A. B. Farquhar Co. (Ltd.) of York, Pa.

A full line of steam pumps, heaters, injectors and engineers' supplies; and in addition to these will own and manufacture the Parker (patent) steam exhaust head, steam separator, steam damper regulator and water filter. This house will sell engines and boilers of all kinds either together or singly, will contract for and build complete electric lighting and electric railway plants and general factory work, and otherwise succeed to and carry on the old business. Mr Parker's friends and clients will find that we will always give the same personal and careful attention to details as heretofore and owing to our greater facilities will be able to give them much better service.

The affairs of the old business up to and including Sept. 30, 1895, will be closed out and settled by Mr. Parker personally.

THE ELECTRIC APPLIANCE COMPANY SPREADS OUT.

The Electric Appliance Company are making some radical changes in the arrangement of their building at 242 Madison St., Chicago. The general office now occupies the second floor, leaving the entire first floor for the store and shipping room. The Appliance Company now occupy the entire building at No. 242 Madison St., four floors, with floor space of about 20,000 square feet and claim to have the largest building in the west which is entirely and exclusively devoted to electrical supplies. They invite their friends to call and inspect the new arrangement of their building of which they are justly proud.

BUFFALO FORGE CO.'S ENGINE IN ELECTRIC LIGHTING.

THE new electric light plant at the Erie, N. J., County House, has been formally accepted by the Supervisors' Committee. The test made in their presence showed about one per cent. variation in the voltage of the dynamo, between no load and 100 amperes. This means that it will require but little regulation as well as attention.

A test of the engine, built by the Buffalo Forge Company, was also made and was very gratifying to all interested parties.

The plant was installed by an electrical engineer of Buffalo, Mr. C. M. White, who was employed by the committee for the purpose. While the number of lights was increased a third the cost of the plant was a third below the original estimate of $3,500 which reflects much credit on Mr. White.

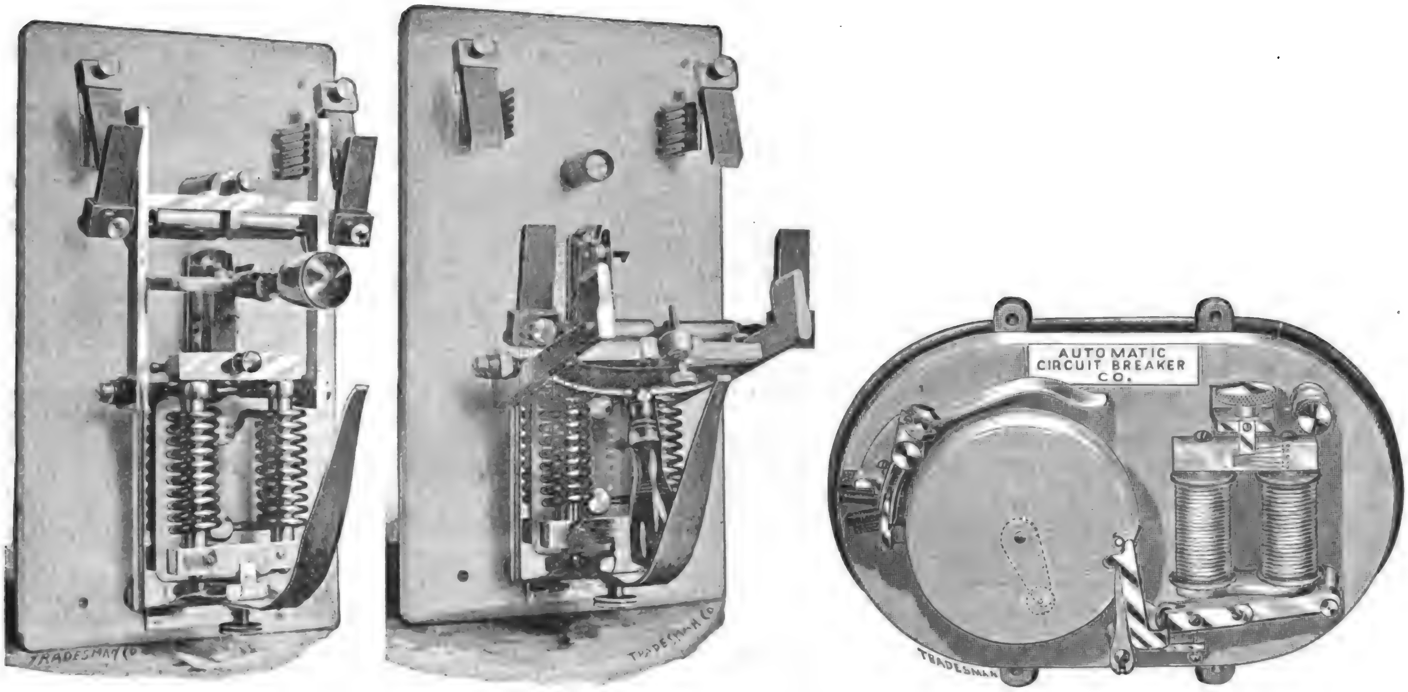
ELECTRIC STORAGE BATTERY CO.

The Electric Storage Battery Company has recently closed a contract for a complete electric lighting plant for Mr. Frank Thomson, Merion, Pennsylvania, Vice-President of the Pennsylvania Railroad Company. The plant consists of an Otto Gasoline Engine, capable of giving 26 actual horse power. The engine is belted to a four pole shunt wound dynamo having a capacity of 20 K. W. The storage battery consists of 60 Chloride Accumulator elements of type 11-G in lead lined tanks. These cells have a capacity of 1,000 ampere hours at a 10 hour discharge rate, but provision is made in the lead lined tanks to double the number of plates, thereby increasing the capacity to 2,000 ampere hours. The power house and storage battery room is situated about 300 yards away from the residence, the current being conveyed by a 300,000 circular mil cable run partly on poles and partly under ground. The power house has been specially designed and built for a private house lighting plant, and the whole installation will be as complete as it is possible to make it.

NEW ENGLAND NOTES.

OSGOOD & BARKER, Bellows Falls, Vt., the well known manufacturers of paper mill machinery at that place, have begun the manufacture of dynamos and motors. They have already several orders on hand, among which is one for a 200-light machine: also for a 2 H. P. motor to go into a boat now using steam. They propose to give special attention to the building of motors for boats and carriages.

THE BEACON LAMP Co., Irvington St., Boston, inform us that they have secured Mr. Eugene McOuat in place of Mr. E. E. Cary, and that the former has assumed charge of their incandescent lamp factory as superintendent. Mr. McOuat entered the electrical field in 1880, with the old United States Company, and later was with Mr. Edward Weston and the Sawyer-Man Co. During this long period, down to the present time, he has been actively engaged in the manufacture of incandescent lamps. The Beacon Co. report business as very brisk.



FIGS. 1, 2 AND 3.—LIMIT SWITCHES FOR MOTORS AND SMALL STATIONS AND CAR MOTOR.

THE APPARATUS OF THE AUTOMATIC CIRCUIT BREAKER CO.

We illustrate herewith some of the leading specialties that are being placed on the market by the Automatic Circuit Breaker Co. of Newaygo, Mich. The object of these devices, broadly, is to ensure against the failure of fuses to operate, and to guarantee,

FIG. 4.—CIRCUIT BREAKER FOR MARINE AND CONDUIT WORK.

as limit switches, the safety of any dynamo, motor, lamp circuit or other part of a system. The limit switch is adjustable within one-hundredth of an ampere, and the current cannot exceed the predetermined amount without the circuit being at once thrown open and protected. In other words, the fuse wire is dispensed with, and its place taken by a device which is not only exact in its operation but acts before rather than after the event.

There are many varieties of these limit switches made by the Company, and we illustrate herewith the motor and small station type, closed and open, Figs. 1 and 2. In Fig. 3 the convenient form applied to street cars is shown; while Fig. 4 illustrates the special form devised for marine or conduit work, mounted on a polished marble base, only 8 by 11 inches, operating in any position and not susceptible to jolts or jars, although instantaneous in its action when subjected to excessive current. There is a small thumb screw by which it can be set even while current is on.

The company make also a special form for alternating current, to be plaed on the primary side of a system; a double pole circuit breaker, or three pole, if desired; a section circuit breaker in pole box, for feeder and trolley lines, a storage battery protecting circuit switch to open on no current or on overload; a manual quick break switch, and a neat form of lightning arrester, for large or small electrical apparatus. It is all compact and well made.

WESTERN NOTES.

THE MUNCIE ELECTRICAL WORKS have been removed to Lafayette, Ind.

MR. J. A. TACKABERRY, Pres. of the John Stephenson Co. of New York City, was a recent visitor to Chicago, and was accompanied by Mr. D. W. Pugh of the same Co.

MR. WILLIAM SMITH, formerly auditor of the National Electric Co., of Eau Claire, Wis., is now with the Halliday Lumber Co. of Cairo, Ill.

THE FARR TELEPHONE AND CONSTRUCTION SUPPLY CO. have just issued their Catalogue No. 2 which is got up in a very neat style, and contains quite a number of illustrations of the telephones, telephone supplies, and other electrical specialties carried by this concern. The reading matter is concise, and consists of a price list of their goods, terms, and other matter. The catalogue is small and convenient to carry in one's pocket, and is one of the things that those interested in this branch of the electrical business would do well to have for reference.

ELECTRICAL CONTRACTORS.—A meeting was held at the Tremont House, Tuesday Nov. 5th, of the Electrical Contractors of the City of Chicago, and a committee appointed by the Brotherhood of Electrical Mechanics, consisting of Pres. Thomas Anderson, Sec'y Geo. Kaufman, and C. B. Quealy, who is Vice President of the Builders' Trade Council.

The object of the meeting was to see if it was not possible to better the existing conditions of the trade in general. With that object in view, the contractors appointed a committee as follows: L. K. Comstock, A. Frantzen, W. Brett and W. M. Meacham, who were to confer again with the Committee of the Brotherhood of Electrical Mechanics, and with the Electrical Contractors of the City of Chicago, and report progress at as early a date as possible.

NEW YORK NOTES.

THE SPRAGUE ELECTRIC ELEVATOR WORKS are to have two large extensions at once to the property at Watsessing, near Bloomfield.

THE ELECTRIC STORAGE BATTERY COMPANY has closed through Messrs. Zimdars & Hunt, a contract for a storage battery of Chloride accumulators for the yacht "Intrepid," auxiliary of the New York Yacht Club.

MR. J. J. ROONEY, who had an interesting article in our last issue describing his new form of storage battery, has his office at 44 Broadway. He is the son of Mr. Rooney, so well known as a representative of the Westinghouse Co. in this city.

MR. H. H. FAIRBANKS, treasurer of the Worcester Electric Light Co. was a visitor to New York last week and a caller at the office of THE ELECTRICAL ENGINEER. He reports business improving and a remarkable demand for incandescent lighting, far beyond expectations for the coming season.

ALONG FULTON STREET.—The North and East River Railroad Company has been reorganized under the name of the Fulton Street Railway with a capital of $500,000 and the following directors: John H. O'Rourke, Arthur H. Smith, John Bray, Peter J. O'Rourke, Edward F. Daily, and John J. Maloney of Brooklyn, and Alfred C. Pette of New Brunswick, N. J.

NEW ENGLAND NOTES.

SPRINGFIELD, MASS.—The mayor has stopped the laying of wooden conduits by the New England Telephone and Telegraph Co., and insisted on iron pipe.

THE SIMPLEX ELECTRICAL COMPANY, of Boston, Mass., are supplying the wire for the Guaranty and Ellicott Square Buildings of Buffalo, the contracts for which were obtained by their Western Selling Agent, Mr. H. R. Hixon, who has also recently closed some other nice orders for his company.

MESSRS. HILLS AND PATTON, of the Perkins Electrical Switch Mfg. Co. of Hartford, Conn., were visitors to Chicago a few days since and were greatly pleased with the good showing that has been made in that territory by their able representative, Mr. Geo. W. Conover.

THE ELECTRIC DIRECTORY CO., F. E. Sanborn, president, T. G. Daly, treasurer, of Boston, has a machine operated electrically which by means of the rotation of a dial furnishes information when required. It can be applied to various purposes, as for instance in a railway depot, in regard to trains.

THE BERLIN IRON BRIDGE CO. of East Berlin, Ct., have just completed a highway bridge over Still River at New Milford, Ct., consisting of one span of 170 ft. with a roadway of 20 ft. wide in the clear. The bridge is 105 ft. above the bed of the river.

PROVIDENCE, R. I.—The new machine shop for The Granger Foundry & Machine Co., at Providence, R. I., will be one of the largest and most complete in the New England States. The building is designed and built by The Berlin Iron Bridge Co., and is 110 ft. wide and 306 ft. long.

MUSIC IN THE G. E. FACTORY AT LYNN.—A strike of the moulders has been going on at the Lynn General Electric factory. The men at work have lately spent their nights within the walls, and to render the long hours less monotonous, a small band of music, comprising two fiddles and a bass viol, now discourses lively airs every evening.

EDMUND COWLES & CO., Gardner, Mass., have sold their electric wiring and repairing business to the Kimball Electric Company of Fitchburg, and will hereafter devote themselves entirely to the electroplating part of the business. Mr. Hibbard is representing the Kimball Electric Company in town, and has several large contracts on hand, among them wiring Heywood's new block and the Syndicate block.

THE MANSON ELECTRIC COMPANY has been recently organized and has recently commenced business with Mackenzie & Macarthur at No. 61 Orange street, New Haven, Conn. D. Edgar Manson, an experienced electrician, is the manager. The new firm will engage in all kinds of electrical contracting, including the installment and repairing of dynamos, motors and storage batteries, and will also make a specialty of isolated plans.

THE STANDARD TURNING WORKS, of Cambridgeport, Mass., are sending out to their friends neat little sample pots of Boston baked beans, the whole thing being a clever specimen of their work in the line that has made Yankee wooden hams and wooden oats famous around the world. The handles, balls, pins, plugs, push buttons and other specialties enclosed are admirable bits of work. The concern carries 75 varieties of wood in stock, many of which are high grade importations, and it turns ivory as well. Prices will gladly be furnished on application.

WESTERN NOTES.

PORTLAND, ORE.—The Oregon Telegraph and Telephone Co. has an underground franchise ordinance granted.

THE FOREST CITY ELECTRIC CO., of Cleveland, O., have opened a branch office in Chicago, under the management of J. M. Atkinson, at 1439 Monadnock Building.

W. N. GRAY & CO., of Cincinnati and Hamilton, O., have issued a very neat little pamphlet of advice to prospective buyers, which they call, "A Short Treatise on Electric Light and Power." There are many excellent pointers in it.

THE ELECTRIC APPLIANCE COMPANY are receiving some flattering testimonials on the Packard Mogul which is certainly growing in favor rapidly for lighting large interiors. A record of several thousand hours life on these lamps is, they say, becoming quite an ordinary occurrence.

MR. D. M. STEWARD, of Chattanooga, Tenn., the inventor of lava insulators, of which millions are now in use, has just brought out another of his many ingenious specialties. This is "Lakelene," a universal cleaner which will wipe out anything, even a national debt or a Tammany record.

LANGSTADT & CROSWELL, of Appleton, Wis., are having a liberal share of the active business that has set in with the general improvement in commercial circles. The firm has just secured the contract for equipping the Grand Rapids Pulp and Paper Company's plant with a Westinghouse multipolar 22½ K. W., D. A. dynamo. The work will be commenced immediately, and 850 lights will shortly be wired up.

THE CENTRAL ELECTRIC CO., of Chicago, are as usual doing a large volume of business, and in addition to their regular stock of electrical goods which this concern carries, they also have a fine supply of miniature lamps, and other electrical specialties, for which there is a great demand at Christmas time for decorating and other purposes. They would ask their customers to bear in mind that the holiday time will be around before very long, and would like them as far as possible to send in their orders for holiday goods early so as to avoid delay, as when these orders are left to the last moment there is the danger of the goods being run out. Those who are at a distance have sometimes not been able to have their orders supplied in time, and consequently suffer considerable disappointment which can readily be avoided if the orders are sent in well ahead of the time the goods are required.

PHILADELPHIA NOTES.

THE PHILADELPHIA ELECTRIC STORAGE BATTERY CO. has been formed in this city to fill a much neglected field of usefulness.

DR. COLEMAN SELLERS, consulting engineer, and Horace W Sellers, architect and engineer, have removed their offices to the Philadelphia Bourse, rooms 537-539.

WARREN WEBSTER & CO., Camden, N. J., have just issued a neat little folder pamphlet devoted to the merits of their Webster Vacuum system of steam heating. There are now over 500 plants using the system, and a list is given of no less than 50 installed since the beginning of 1895.

THE WIRT BRUSH.—We have received from Mr. Charles Wirt, Cor. Ludlow and 31st Sts., Philadelphia, a copy of catalogue of the Wirt Brush, which contains practical information, interesting to engineers, drawn from an extended experience and intimate acquaintance with the practical provisions under which dynamos are worked.

ADVERTISERS' HINTS.

THE GENERAL ELECTRIC CO., in their "ad" this week give us a glimpse of some of their direct connected generators running in one of the largest central stations in the U. S.

MR. JAMES G. BIDDLE, as agent for the Electric Storage Battery Co., supplies batteries for any use to which they may be applied.

COMMUTATOR BRUSHES for any make, style or size of generator or motor are made by Mr. Charles Wirt. The H. T. Paiste Co., of Chicago, are the western agents.

THE STANDARD AIR-BRAKE CO. announce that they are ready to equip with brakes, cars making forty-five to sixty miles as well as those of slower speeds for city service.

THE METROPOLITAN ELECTRIC CO., of Chicago, have secured the western agency for the celebrated "Ship Cored" carbons. Mr. F. S. De Ronde, 2 Liberty St., New York, is the general American agent for the manufacturers, Schiff, Jordan & Co.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.

Vol. XX. NOVEMBER 20, 1895. No. 394.

THE BOUGHTON TELEPHOTOS FOR LONG-DISTANCE VISUAL SIGNALLING.

MODERN commerce not less than modern warfare frequently makes it desirable to establish communication where it is impracticable to string wires. As examples of this we need only mention the great desirability of ships at sea being able to communicate with one another at night, or the communication between light ships and outlying light houses and the shore, etc.

To afford a simple apparatus for this purpose Mr. C. V. Boughton, of Buffalo, N. Y., has devised what he terms a telephotos. The apparatus consists of a keyboard similar to that of a typewriter, and a flexible shaft provided with white and red incandescent lamps of any candle power desired, which are used to denote the dot and dash of the Morse system, or any other system that can be made by dots and dashes. The shaft weighs twenty-nine pounds complete, and can be run up to the peak, yard or top mast

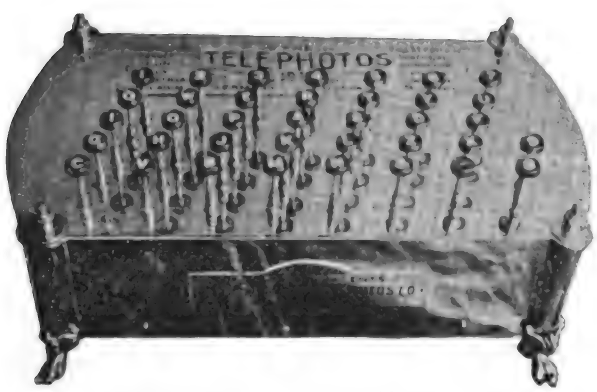


FIG. 1.—THE TELEPHOTOS KEYBOARD.

as quickly as a flag. It is provided with a coupling like that used upon a fire hose with which each electrical connection is made with one effort; and all connection wires are out of sight or reach within the shaft.

The signals from this shaft are seen in every direction. The key-board and staff when working, have eighty-six parts, which are not complicated and hence not liable to get out of order. The key-board has a plainly marked key for each letter and numeral, arranged as in the typewriter with regard to importance or frequency of use.

Fig. 1 shows the key-board, which is 4 inches high, 8 inches wide and 14 inches long, weighing but thirty-four pounds, all told. Fig. 2 shows staff No. 1 used for quick work. Its length is forty feet and its weight, twenty-nine pounds. The distance between the lights is eight feet. It is so constructed that it can be seen in any direction. The lamps are twelve in number, of 100 C. P., and can be seen distinctly ten miles. The time required for putting the system in place ready to signal, is about three minutes, and it is so light that it can be run up with any flag halyard.

The engraving, Fig. 3, shows part of staff No. 2, provided with globes. Its length is forty feet; weight with all lamps upon it, sixty-eight pounds. The weight of each lamp is five and one-half pounds, the number of lamps being six. The distance between lamps is eight feet. The length of both staff No. 1 and No. 2 is governed

FIG. 2.—STAFF FOR QUICK WORK.

entirely by the distance to be signalled. This staff is as easily handled as staff No. 1, and does not become a fixture unless desired, upon the ship. When not in use, the six lamps are removed and the staff coiled up like a rope. Fig.

FIGS. 3. AND 4.—STAFF WITH GLOBES READY FOR USE.

4 shows the lamp in place upon the staff ready for use, so that it can be seen all round, by the entire fleet at the same time.

The large sphere of usefulness of a system like that just described not only for naval and military purposes, but also for the regular merchant marine service, light house and lightship work, is apparent.

Thus the telephotos permits of ready interchange of communication along the coast between land and sea forces employed conjointly; between expeditionary bodies of troops, and their outlying points of observation; and without in the least decrying the importance of the field telegraph or telephone, we think it will accomplish what neither of them has yet attained or can attain to, that is, send its messages without the aid of extraneous wire, anywhere within the limits of vision. It can obviously move side by side with an army in its strategic changes, and, so to say, be directed to any point and be doing good work long before wires can be strung along and made ready to operate upon.

It is not claimed that a visual signal like the telephotos overcomes all the atmospheric difficulties with which flags, cones, semaphores, heliographs and similar signals have to contend, nor is it advanced as a competitor of the field telegraph, but within the limits of vision it is asserted to allow of more rapid and certain communication than any other visual signalling system.

THE DURABILITY OF PORCELAIN AS AN INSULATOR.

BY JAMES PASS.

In THE ELECTRICAL ENGINEER of Sept. 24th there is an interesting article by Mr. A. E. Dobbs, questioning the durability of porcelain as an insulator, and which comment I am glad to see because it calls attention to a condition of things which is worthy of thought and investigation by all who are interested in the permanence of electrical insulation.

It can hardly be questioned that porcelain, when skillfully compounded and carefully made, is an excellent and durable insulator. The recorded experience with this material for aerial lines in England, where it is used in preference to all other materials, should have some weight. It seems also to be well established, so far as laboratory tests can establish such claims, that porcelain, when well made, is a better insulator than glass, especially for high voltages. But how are we to know that the insulator which looks well and lasts well to-day will still be a good insulator five years hence?

Laboratory tests do not enlighten us on this point and appearance is no indication whatever. Of course, certain gross faults may easily be detected; such as an imperfect vitrifaction, etc. But to make a porcelain body which is perfectly vitrified and yet has considerable strength to resist fracture requires experience and technical skill; and to make such a porcelain and cover it with a perfect glaze that will not crack in time has from the dawn of the pottery industry taxed to the utmost the skill and ingenuity of the practical potter.

This cracking of the glaze is called among potters "crazing" and is generally known by that name; perhaps from the fact that its unwelcome and unexpected appearance has driven so many good men to the brink, if not into the slough, of mental despair.

The glaze used on porcelain is quite peculiar and there is little resemblance between the formulas for this glaze and those for ordinary glass. A porcelain glaze must attach itself very firmly to the body, when heated to near the melting point of that body, and it should have as nearly as possible the same co-efficient of expansion as the body which it covers. The exact adjustment of glaze to body is difficult to attain, the glazes having usually a larger co-efficient of expansion than the bodies. That is, they are affected to a greater extent by changes of temperature; and if the difference is considerable, it will be seen that the glaze is in a state of tension. Sometimes, when the adjustment of glaze to body is very bad, a piece of ware will be found glaze-cracked, or "crazed," when it is taken from the kiln—for the difference of contraction begins as soon as the glaze, in cooling, loses its viscous property, becomes brittle and this is cumulative as the temperature is reduced.

A very serious feature of this "crazing" is that unless the adjustment is very bad as mentioned above, the "crazing" may not take place at once but may occur at any time. It usually occurs within two or three years after manufacture, according, *principally* to the more or less uniform expansion and contraction of body and glaze, but also influenced slightly by other conditions; and this increasing liability to "craze" we will endeavor to explain.

It is well known, especially to manufacturers of thermometers, that there is a tendency in glass to continue contracting slightly for some months after manufacture; so that a thermometer, if filled and graduated soon after the tube and bulb have been formed will gradually read high, usually not exceeding one degree. This tendency to continue contracting after manufacture is quite marked in glaze that is suitable for porcelain; and if at time of manufacture the glaze is under sufficient tension, though not enough to cause fracture at the time, the increasing strain brought about by this further contraction of the glaze causes "crazing" sooner or later. A piece of porcelain ware which has done good service in the first year of its life may be rendered useless in the second year, or later, by "crazing;" and a porcelain insulator which looks well, even lasts well in the laboratory, may be of little value for insulating purposes within a short time after manufacture

"Crazed" porcelain should never be used as an insulator, for when subject to moisture the fissures in the glaze fill with water by capillary action, forming excellent channels for leakage of current. It should be a source of regret that such large quantities of defective porcelain have been used in the construction of electrical devices. We know of reputable manufacturers of electrical apparatus who have assembled and sent out in the market to do service in permanent installation tons of this defective porcelain; and we have seen again some of the same articles that had evidently done service in a damp place and every crack in the glaze was filled with verdigris.

It is certain from the observations of the writer that there is a much larger percentage of "crazing" in porcelain manufactured for insulation than in that which is used for table-ware; and the reason for this is not hard to find. First, there has been a considerable amount of amateur effort in this branch of potting. Second, everything passes inspection which is sufficiently accurate mechanically to admit of its being assembled. Third, price seems to be the only thing considered by the people who buy porcelain for electrical purposes.

Some manufacturers of electrical supplies deliberately abandon porcelain which they know by experience to be of good quality and purchase cheaper material; and even though it be "crazed" when it comes to their hands they assemble and send it out for use in first-class construction work, where it is accepted because it is "porcelain," without any regard to its qualities.

Good porcelain can be had and at reasonable prices as compared with the cost of porcelain for other purposes; but poor porcelain that is "crazed," or is liable to craze, or is imperfectly vitrified, will be used because it is cheap and "passes inspection." It should be required that all porcelain bear the manufacturer's name, and a rigid inspection should prevent the use of "crazed" porcelain in new work or its continued use in old work. This, we think, would in a short time give us a better insulating material and one that could be depended upon.

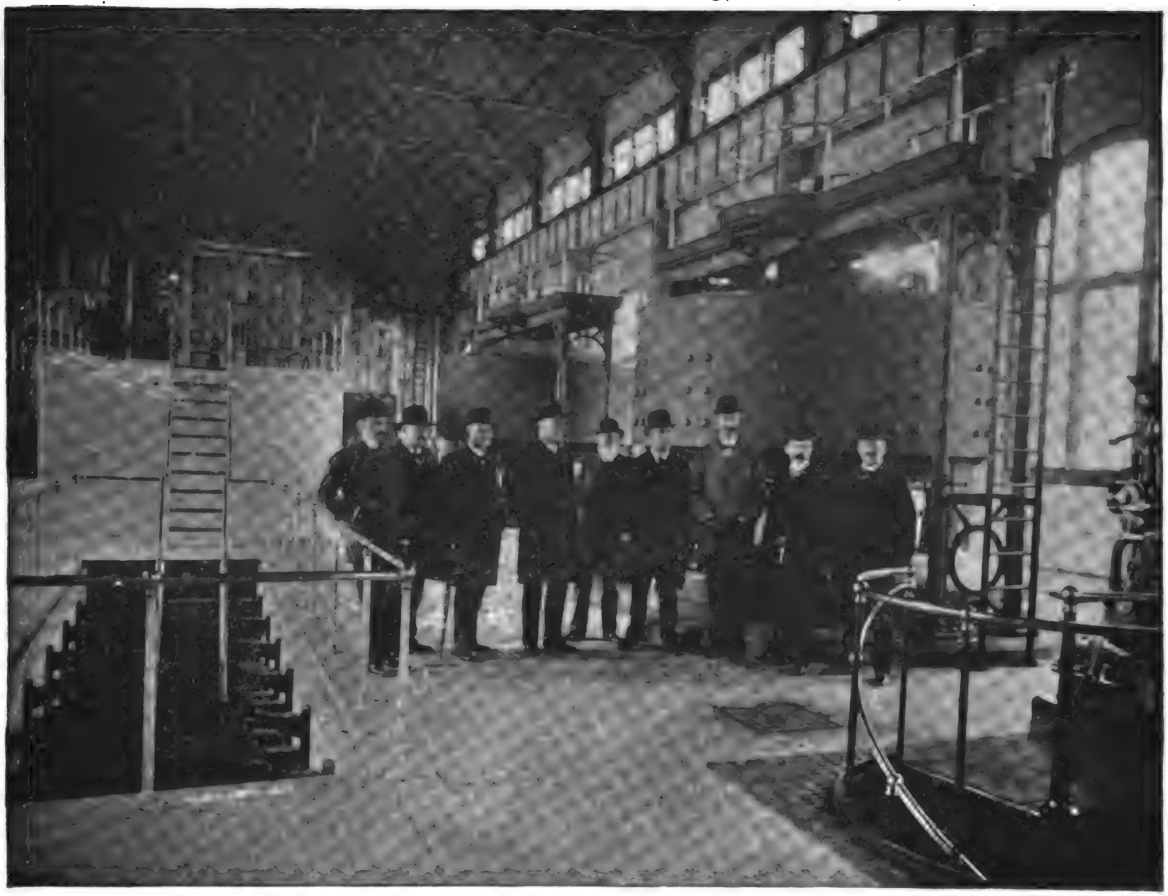


FIG. 1.—INTERIOR OF NIAGARA POWER-HOUSE.—LATEST PHOTOGRAPH SHOWING PLANT IN OPERATION.

BUS BARS AND CABLES IN THE NIAGARA POWER HOUSE.

From time to time the readers of THE ELECTRICAL ENGINEER have been presented with data and illustrations exhibiting the progress made in the great work for the electrical utilization of Niagara, and particularly with regard to the central power house within whose walls so much new and interesting machinery is concentrated. One of the details in regard to which little has been said hitherto is the method of taking the current from the large dynamos and passing it through the switchboard for distribution; and we are glad now to be able to furnish some very interesting information on that point.

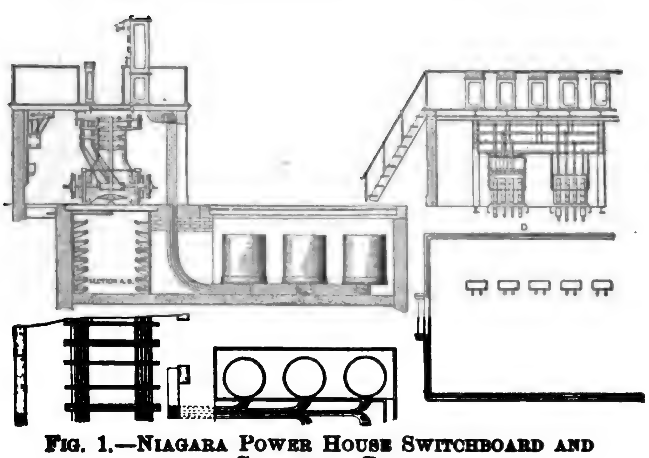


FIG. 1.—NIAGARA POWER HOUSE SWITCHBOARD AND CONDUCTOR PIT.

The arrangement of the power plant is well shown in the perspective engraving, Fig. 1, which is taken from the last photograph made of the interior, the occasion being that of the recent visit of the officers of the Niagara Power Co. The two-phase dynamos range along the right, and that on the extreme right in the picture, is running and delivering at that moment a large proportion of its normal 5,000 H. P. At the left is the switchboard or switch platform, with stairs underneath giving access to the subway immediately below the board. Figs. 2 and 3 give an excellent idea of the internal arrangement of the board.

Fig. 4 shows the cable used in carrying the current from the dynamos to the board. About 1,200 feet have been supplied for that purpose, after test under 45,000 to 48,000 volts, alternating current. There are 427 copper wires in the cable consisting of 61 strands laid up in reverse layers, each strand consisting of 7 wires. Next to the strand of copper is a wall of rubber one-quarter inch thick, double coated. Over this is wrapped absolutely pure rubber, imported from England and known as "cut

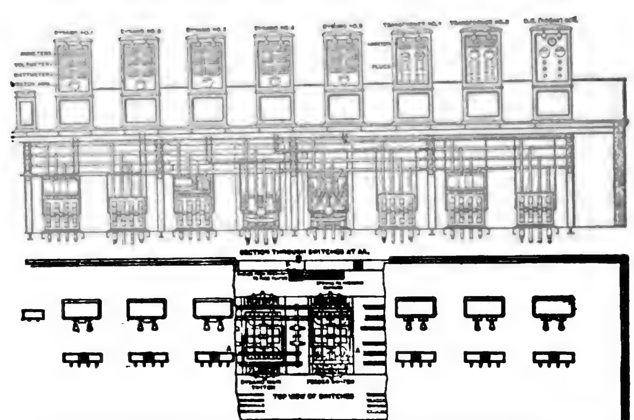


FIG. 3.—ARRANGEMENT OF THE NIAGARA SWITCHBOARD.

sheet." Then come two wrappings of vulcanizable Para rubber; over that a wrapping of cut sheet, and on top of that two more rubber coats. It is then taped, covered with a substantial braid and vulcanized. The object of

Fig. 4.—Cable from Dynamos to Board.

the cut sheet is to vulcanize it by contact merely, in order to make it thoroughly watertight. This cable weighs just over 4 pounds to the foot, of which 3 pounds are copper and 1 pound is insulation.

The Niagara bus bars are eight in number, and 50 feet 4 in. long, each having 10 offsets. The bars are made up of five components. The centre and the intermediate components are seamless copper tubes made up by drawing a quarter inch tube over another of the same size, the wall being $\frac{1}{4}$ inch thick. The end components are solid bars of copper $1\frac{1}{4}$ inches thick. Fig. 5 shows, in exact size, the middle component of the busbars, the outer large circle being the insulation, the inner large circle being the copper tube, and the central hollow space being closed up partially for convenience in handling the sample.

The diameters of these great busbars are as follows: Centre component 8 feet long; 3 inches outside diameter, 2 inches inside, equaling a circular section of 5,000,000

Fig. 5.—One of the Niagara Bus Bar Components—Full Size.

circ. mils. Intermediate component, 8 feet 6 in. long each (2 of them); 2 inches outside diameter, 1 inch inside; equaling a circular section of 3,000,000 c. mils. The ends, solid (2 of them), 10 feet 11 in. long each, $1\frac{1}{4}$ inches in diameter, equaling a circular section of 1,562,500 circ. mils.

These bars are screwed together, with a length of entrance of 10 inches, then thoroughly soldered, and the entire outside tinned. The method is shown in Fig. 6. There are no corners or projections whatever on these bars. Each component has two offsets, consisting of split sleeves accurately fitted, screwed together with long-headed screws, the heads filed off flush, and finally soldered to the bar. The elbows, being the terminals of the cables, are taper-fitted to the ends of the offsets, and fastened with a counter-sunk screw. The entire system is then insulated by wrapping a perfectly pure rubber compound and pure rubber in alternate layers, building up a wall $\frac{5}{32}$ inch in thickness; then covered with thin rubber covered cotton tape, and wrapped outside with a rubber covered drill tape. The bars were vulcanized in a special apparatus 55 feet long, consisting of a number of 18 inch tubes bolted together; a 4-inch I-beam riveted to the top of this and continued outside for 50 feet, with ten small trolleys on it from which each bar was suspended by the offsets. The covered bars were then put into the vulcanizer by means of their ten trolleys, closed up, and cured in live steam.

For this interesting work the bars and Habirshaw cables were made and furnished by the India Rubber and Gutta Percha Insulating Co., and the bars were specially devised

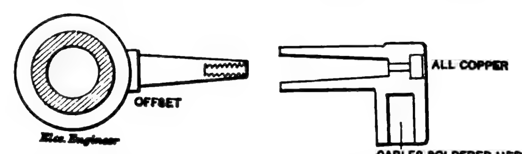


Fig. 6.—Method of Joining Niagara Bus-Bars.

and worked out by Dr. W. M. Habirshaw in co-operation and consultation with Mr. L. B. Stillwell, on behalf of the Westinghouse Co. The effective pressure guaranteed on the cables which are made under one of Dr. Habirshaw's patents, is 10,000 volts alternating. The quarter-inch wall when tested under water broke down at about 48,000 volts, and cables having a wall of $\frac{5}{16}$ and $\frac{3}{8}$ inch withstood a test of 52,000 volts; this being the extreme range of the testing apparatus, contact being kept on for one minute without effecting any perforation.

The copper for the busbars was furnished by the American Tube Works, Boston. The screws were cut by the Brown & Sharp Mfg. Co., of Providence. The bars were fitted together and made up entirely at the Habirshaw Glenwood Works at Yonkers, and shipped in one length to Niagara in a special car, over the New York Central. They are now all in place on the switchboard.

LIGHTING BY LUMINESCENCE.

In a paper read by M. A. Witz before the Académie des Sciences, the author gives the results of his attempts to measure the quantity of energy necessary to illuminate Geissler tubes. The figures that he has obtained show that in lighting by luminescence the proportion of calorific energy as compared with the total energy is feebler than in any other luminous source. The author thinks that by reducing the losses of electricity to a minimum, by concentrating the light in a confined space, by utilizing the fluorescence of certain substances, and finally, by devising certain special arrangements, one may hope to obtain luminous sources whose photogenic rendering will be superior to the best now known.

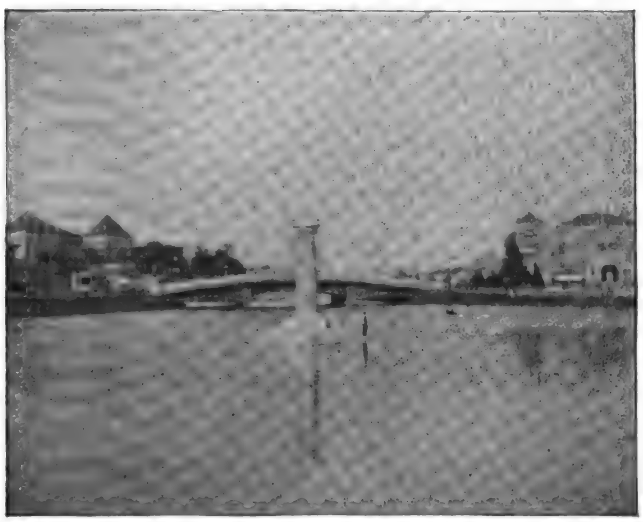
A COSTLY NEW YORK FRANCHISE.

The franchise for the King's Bridge Road extension has been bought from the city by the Third Avenue Railroad at $88\frac{1}{8}$ per cent. of the gross receipts, above the upset price, which is 3 per cent. of the gross for the first five years and 5 per cent. thereafter.

Electric Lighting.

A FLOATING PILLAR OF LIGHT AT ATLANTA.

While the Atlanta Exposition is by no means to be compared with the Chicago World's Fair for magnitude and general interest, there are many respects in which it compares on equal terms. Size does not necessarily imply excellence, and various exhibits at Atlanta have been so carefully collected and selected that they show within their moderate compass all that is latest and best. It is true, also, that in respect to special effects and illumination, Atlanta compares very favorably with what has gone before, and offers besides some things not hitherto seen. Of course, there are electric fountains, but one of the great novelties in connection with the water-and-light display is the floating tower. It is moored in the large and beautiful lake known as the Clara Meer, and flanks the central electric fountain, although at such a distance that the individual effects are quite distinct. It is needless to say that this tower, like the fountains, owes its origin to



The Atlanta Floating Tower of Light.

the fertile fancy and constructive skill of Mr. Luther Stieringer, the consulting electrical engineer of the Exposition. It rises more than 30 feet from the lake and rests on a circular platform, which is buoyed up by oil barrels, contributed for the purpose by the Standard Oil Company. It is of wood, and it goes without saying that the wood is choice Georgia pine. Around the stem of the tower run spirals of Edison miniature lamps of 6 c. p., hundreds being employed; and there are a large number of lamps also in the capital. These lamps are on different circuits which can be commutated automatically or by hand. Current is led to the Tower from the shore by a submerged Safety cable, six or seven hundred feet long, and is furnished by an Edison bipolar dynamo. The installation as a whole was made and supervised by the General Electric Co. The lights are flashed in and out with a striking and even weird effect, and the illumination is so strong as to brighten up the whole of the section of the lake and exposition park in which it stands. We are indebted for the photograph from which our cut is made, to Mr. Gus Voigt, a scenic artist of more than local fame, who was associated with the work. The tower is greatly admired and its kaleidoscopic effects are no small puzzle to the innocent country folk and darkies, who see it "winking at them," as they say, in a very bold manner, across the glowing waters of the lake. The plan adopted is suggestive of an entirely new range of marine spectacular effects, combining a plant on shore with a movable scene afloat.

THE ELECTRIC LIGHTING OF EDINBURGH.[1]—I.

BY HENRY R. J. BURSTALL.

The electric lighting of Edinburgh, as is also the case in many of the most important towns in England and Scotland, is in the hands of the Corporation; and was finally decided on late in 1893, when the work of designing and superintending the whole scheme for public and private supply was entrusted to Prof. Kennedy. Work was commenced at the station and in the streets in May, 1894, and the station was opened for the continuous supply of electrical energy on April 11, 1895, the exceptionally severe winter having seriously delayed the progress of the station buildings.

Districts.—From the electrical point of view the City of Edinburgh may be said to consist of two districts, differing from each other both in character and in their positions relative to the centre of the city. The older part of the city by the Castle, and the district north of Princes-street, include the greater part of the business premises, together with a residential district in which the houses are large and closely built, and where the demand for current may be expected to be great. The district to the south and east of the central portion is either residential or of such a character that the demand for current can never be as large as that in the northern and central district. The residential part of this district contains many houses which stand detached from one another, thus diminishing considerably the possible number of lamps in proportion to the frontage. Having regard to the different districts to be served, and taking into account all the local circumstances, it was decided, after comparison of the various systems of supply and distribution which could be used, to adopt a low-tension three-wire system for the central and northern district, and an alternating-current high-tension system for the southern and eastern district, both systems being worked from one central station and under the same control and management.

Station.—The building, which is a handsome brick erection with brown stone frontages to Dewar-place and Torphichen-street, is from the designs of Mr. J. Cooper, the burgh engineer, and was erected under his superintendence. The site is roughly triangular; the boiler house occupies nearly the whole of the north side, and the two engine rooms are parallel to and south of it; she general offices occupy the extreme south of the site, and are targe enough for the accommodation of the whole of the clerical lstaff, as well as for the resident engineer and his assistants. Above the boiler room are the workshops, and the floor above the western end of the engine rooms is used for the battery room, store room, and meter store and testing rooms. It is designed to contain 17 boilers, of which at present only the six at the west end are in place.

The boilers are of the dry-backed marine type, each 10¼ ft. mean diameter and 12 ft. long, with two Purves flues, 3¼ ft. inside diameter, and 166 tubes of 3 in. internal diameter. The boilers are of steel, with wrought-iron tubes, and have been built in accordance with Board of Trade rules for a working pressure of 160 lbs. per square inch above atmosphere. They are fitted with the usual mountings, and have duplicate feed check valves.

On the top of the boilers are fitted superheaters, each consisting of two nests of tubes enclosed between the top of the boiler shell and a fire-brick casing above, with a space left in the centre for the steam valves, safety valve, &c.

The pump room is opposite the chimney, and is entirely closed in. It contains at present one duplex steam pump and two three-throw pumps driven electrically; each pump has a maximum capacity of 4,500 gallons per hour. The electrically driven pumps are specially designed to run with a large range of speed; and for this purpose can be connected with either the 230-volt or the 115-volt mains. The steam pump has its steam supply connected with two points of the main steam pipe, and its exhaust is connected with the feed heater. Each feed pump has an independent suction from the feed tank, and two independent deliveries into two separate lines of pipes, each of which can be connected with either range of the two duplicate rings of feed pipes, either through the feed heater or direct.

Under the pump room is the feed tank, which communicates with a large storage tank at the end of the boiler house; another feed tank is also provided under the workmen's room, so that there is an ample reserve of water in case of accident to the water supply. A siding from the Caledonian Railway runs into the boiler house, and the coal brought in the railway trucks is at present stored in the east end of the boiler house; on the station being extended, the coal will be stored over the boiler house, and let down through shoots to the mechanical stokers.

Engine Rooms.—The engine rooms (Figs. 1 and 2) are each about 102 ft. long, and are side by side, forming really one room divided by a line of columns which carry the roofs and the beams for the travelling cranes. The engine room next the boiler house is reserved for the low-tension plant, and is 46½ ft. wide; the other contains the high-tension plant, and is 41½ ft. wide. A platform, raised 4 ft. above the engine room floor-level, runs the

1. Abstract of a paper read before the Institution of Mechanical Engineers.

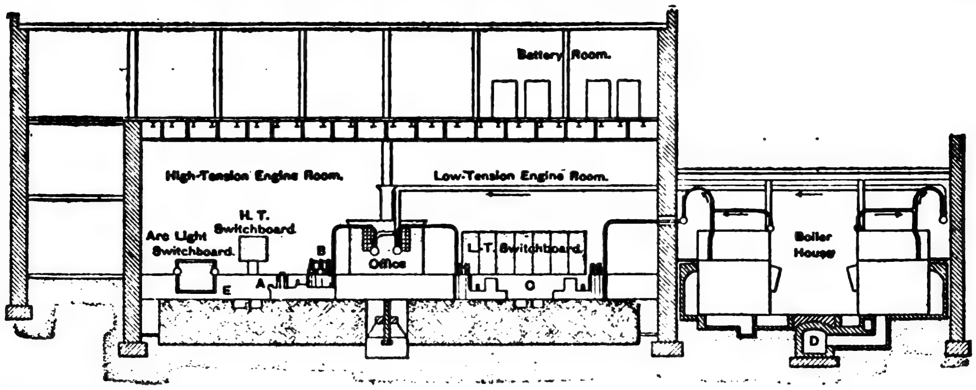


FIG. 1.—ENGINE ROOMS AND BOILER HOUSE, EDINBURGH MUNICIPAL ELECTRIC LIGHT STATION.—"A," ALTERNATORS; "B," 150 H. P. ENGINES; "C," 100 H. P. ENGINES; "D," MAIN FLUE; "E," RECTIFIERS.

whole way across the west end of both engine rooms; and on this are placed the switchboards and regulating gear for both the low and high-tension systems, as well as the office of the engineer on watch.

Low-Tension Engine Room.—The machinery at present in the low-tension engine room (Figs. 1 and 2) consists of eight engines, four of 100 I. H. P., two of 250 I. H. P., and two of 360 I. H. P., with their dynamos; and provision is made for eight more engines of 360 I. H. P. in the future. All are Willans central-valve engines driving their dynamos direct. All the dynamos are two-pole shunt-wound machines with drum armatures, all wound to give 270 volts, except two which are driven by two 100 I. H. P. engines; these two are wound to give 135 volts, being used as balancing machines on the three-wire system.

The steam-piping forms, with part of the boiler-house ring, a complete ring round the low-tension engine room (Figs. 1 and 2), and is connected with the boiler-house ring at two points. The main ring is 8 in. internal diameter throughout; the straight lengths are of steel, with thick flanges screwed and brazed on; the tee pieces and valve boxes are of cast iron, and the bends of copper with steel flanges. All bends are of large radius, and no expansion joints are used or required. The engines are erected in pairs, and are connected with the main ring by two long copper bends (Figs. 1 and 2); in the main ring a valve is placed between the branches to the two pipes, with a cross-over pipe and valve at the

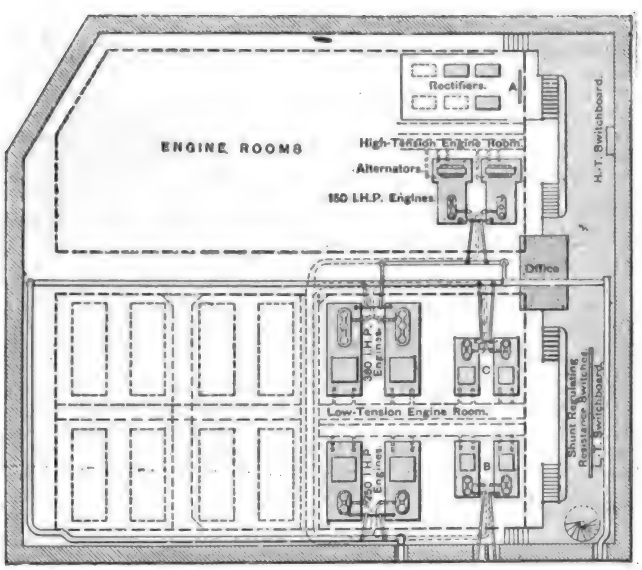


FIG. 2.—PLAN OF ENGINE ROOMS.—"A," ARC LIGHT SWITCHBOARD; "B," BALANCING MACHINES; "C," CHARGING MACHINES.

engines, so arranged that the engines can take their steam from either side of the valve in the main ring. The pipes are slung by long rods from brackets fixed on the walls or columns, so as to allow free movement.

All the engines are fitted with cooling pipes in the crank chambers, to which the water is carried in a line of pipe round the engine foundation block, and taken thence to the feed tank by a second line. Each engine is fitted with a valve on the exhaust; the exhaust steam is led by a copper bend into the main exhaust pipe, which is carried in chases in the engine foundation block and along the void between the block and the walls. The main exhaust pipes are of cast iron, and are led through a Berryman feed heater in the boiler house to the chimney (Figs. 1 and 2). Only one heater is fixed at present, but provision is made for three more when required. From the heater the exhaust steam is carried up to the top of the chimney by a vertical cast iron pipe 21 in. in diameter. Valves are provided so that the exhaust steam can be carried direct to the vertical exhaust pipe, without going through the heater.

The whole of the machinery stands on a concrete foundation-block 7½ ft. thick, which is separate from the foundations of the walls. A void 3 ft. wide is left at each side of the block, which is also stopped some distance in front of the switchboard platform, thus forming a large chamber at the west end of the two engine rooms for the connections, &c. An 8 ton traveling crane, running the whole length of the engine block, is provided in each engine room, for convenience in overhauling, &c. These cranes are worked entirely from below by means of ropes.

Leads.—The main leads from the dynamos are drawn through curved wrought-iron pipes let into the concrete, into chases in the centre of the engine foundation-block, along which they are carried to the chamber under the switchboard platform The leads from the field winding of the machines are also carried in the same manner to their regulating resistances, which are placed under the platform; the switches for these resistances are fixed upon the handrail on the platform, in front of the switchboard, the leads from the resistances being brought up through the posts of the handrail.

Switchboard and Conductors.—The switchboard, and the whole of the apparatus for regulating the dynamos and batteries, and for the distribution of the current, are placed on the platform and are directly under the eye of the engineer in charge. The switchboard consists of seven slate panels, each about 7 ft. high; and stands 4 ft. from the west wall of the engine room, thus allowing ample room to do any work on the connections, &c., at the back. The instruments and gear for regulating the battery are mostly placed on the centre panel, and those for the switching and manipulation of the dynamos and feeders are on the six outer slates; the connections for the positive side of the system are on the left hand, those for the negative on the right, and the middle wire is connected on the centre panel.

THE EFFECT OF BRIGHT WEATHER IN NEW YORK.

It is a fact within common knowledge that dull weather creates a need for more artificial light in the daytime, but the exact figures are not often obtainable. The Edison Electric Illuminating Co., of New York, reports that during the month of October last, there were 628 clear hours as compared with only 487 clear hours in October, 1894. The result of this was that the earnings for incandescent lighting for the month fell $8,661 below the figure for the corresponding month in 1894. Owing, however, to the marked general gain in all other departments, the company's earnings for the month were $148,219, or only $336 less than in October, 1894.

WELSBACHS IN HARTFORD, CONN.

A report at the last meeting of the Hartford, Conn., Street Board as to the lighting of Ford Street Bridge disclosed the fact that the lighting was unsatisfactory. A summary of the report showed that in the thirty lights there were six good mantels, 11 burned out, 11 with holes burned through, 2 out of place, six mica chimneys broken, and three outside cylinders cracked. Out of the thirty lights just 20 per cent. were in good condition so far as the Welsbach burner was concerned. But even these shared with the others the diminution of lights caused by the dirty outside cylinders. The report concluded as follows: "In a word, the whole outfit indicates a most lamentable neglect and want of care and attention."

THE SIEMENS & HALSKE "BAND" LAMP FOR CONSTANT POTENTIAL, DIRECT AND ALTERNATING CURRENT CIRCUITS.

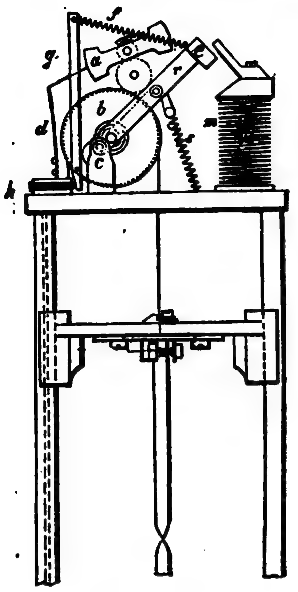


Fig. 1.

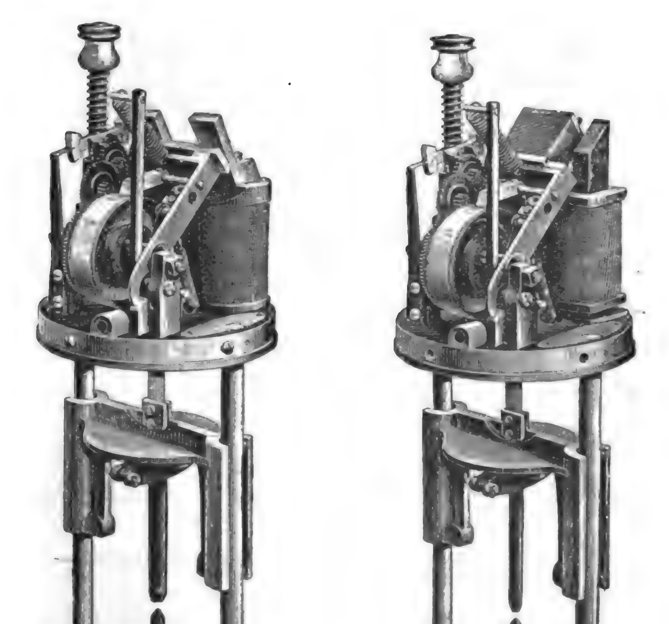
THE accompanying illustrations represent the so-called "band" lamp, manufactured by the Siemens & Halske Electric Co., and intended for constant potential circuits of all kinds.

The lamp derives its name from a copper band or ribbon which carries the upper carbon holder, and which conducts the current to the upper carbon.

The construction of the lamp will be readily understood from the engraving, Fig. 1. An inclined frame *r* turns on pivots *c* and supports the drum *b* around which the copper band is wound. This frame also supports the train of wheels with the escapement, and, at the upper end of the frame, the iron armature *e*. The attraction of the shunt magnet *m* and the weight of the upper carbon and holder draw the frame *r* downward, while the spring *f* pulls in the opposite direction. The unwinding of the copper band causes the drum *b* and the pinion wheels to revolve, while the escapement with its balance lever *a* oscillates rapidly.

When the frame *r* is near its highest position, a tongue projecting from the lever *a* strikes the stop *g*, and the motion of the clockwork ceases. When the frame *r* is drawn downward the escapement is released, and the copper band gradually unwinds from the drum, while the upper carbon holder sinks slowly by gravity.

When the current is turned on the frame isdrawn downward by the shunt magnet, and the copper band unwinds until the carbons touch. The current then flows through the carbons instead of through the shunt, and the magnet loses its attractive power. The spring *f* draws the frame up again and forms the arc between the carbons. As the carbons are consumed at the points, the arc

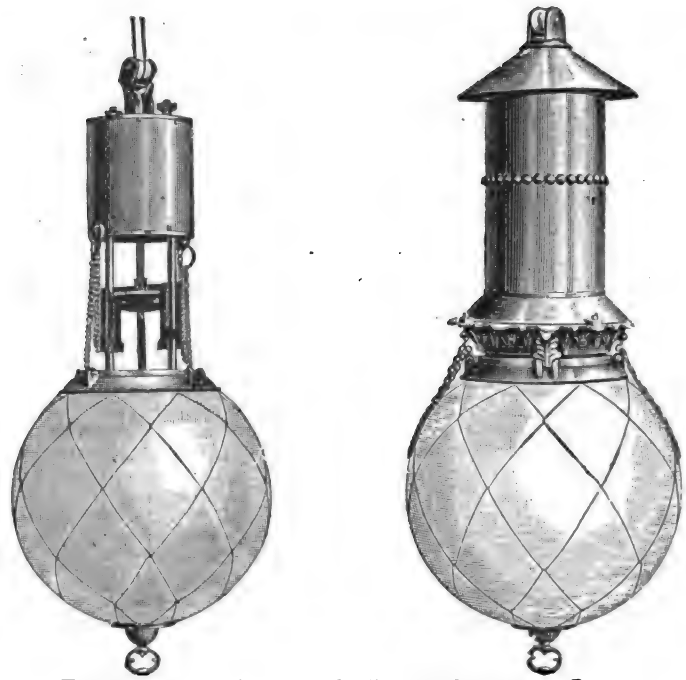


FIGS. 2 AND 3.—SIEMENS & HALSKE CONTINUOUS AND ALTERNATING CURRENT BAND ARC LAMPS.

grows longer, the current in the shunt magnet is increased gradually, and the frame is drawn down to a position which it will retain permanently. The slightest change in the length of the arc will start the escapement, and this will cause the lamp to feed gradually.

Among other details of the working parts of the lamp, which cause it to burn quietly and steadily, may be mentioned: The dash-pot to check a too rapid motion of the frame; a contrivance which makes up for loss of weight caused by the burning of the upper carbon; and the peculiar shape of the pole shoes and armature. The whole mechanism is fastened to a cast-iron plate, and is closed above by a cast-iron cover, which encloses the terminals. The lower cross-piece serves as a carbon-holder; a ball and socket joint carries the clamp for the lower carbon. The arc descends gradually as the lower carbon is consumed. The carbon clamps are adjustable, so that carbons of different diameters can be held by them, and they can be properly centered by means of the lower holder.

Fig. 2 illustrates the direct current lamp. In the alternating



FIGS. 4 AND 5.—SIEMENS & HALSKE BAND ARC LAMP.

current lamp, Fig. 3, the core of the magnet and the armature are made of laminated iron, to prevent heating by Foucault currents. The lamp globe is held by two hooks; when the lamp is to be trimmed the globe may be lowered, and be kept so suspended by means of chains, shown in Fig. 4. The lamp ready for operation, with ornamental shield and globe is illustrated in Fig. 5.

The Siemens band lamps are intended for use on constant potential circuits only. On a 110-volt circuit two direct-current lamps or three alternating lamps may be connected in series with a resistance, which latter uses up the surplus voltage.

The company also makes an adjustable resistance consisting of high-resistance wire wound on porcelain ribbed cylinders mounted on cast-iron bases, and covered with metal shields. The resistances are made for either indoor or outdoor use.

A PLANT OFFERED ON THE INSTALLMENT PLAN FOR SEATTLE, WASH.

WHEN the Seattle, Wash., board of public works opened the bids for street lighting for the coming year, 1896, it found among them a proposition to erect a new plant and sell it to the city on the installment plan, the owners meanwhile furnishing light at prices far below those of the other bidders. The proposition was afterwards explained orally in more detail. This proposition came from F. H. Osgood, A. L. Hawley and J. T. Robinson. Mr. Osgood is an electrician and railroad man. He built the first street railroad and also the first electric railroad in Seattle, and is now the owner of the Rainier avenue electric line. A. L. Hawley and J. T. Robinson have for several years been connected with the Union Electric Company, of Seattle, the former as assistant manager, and the latter as secretary, but resigned recently.

They offered to erect and install an electric light plant, with all the necessary appliances and devices, and to sell the same (not including steam plant, dynamos or station equipment) to the city for $66,000, in thirty-six monthly payments, of $1,833 each, such installments to be paid on the 20th day of the month succeeding the operation of the plant, and continuing monthly thereafter. The city, under this contract, shall furnish water and pay any and all taxes, and grant to the contractors a franchise to erect poles and string wires for the purpose of furnishing heat, light and power, on the terms of existing franchises, including the

right to construct and use underground conduits. For the lighting of additional lamps that may be ordered by the city during the operation of the contract, the contractors propose to charge for arc lamps $7.25 per month, for incandescent fifteen-candle power lamps $1, and pro rata for those of greater power.

The city is to give the contractors during the existence of this contract the right to carry on the same poles and through the same conduits wires for commercial lighting, and after the expiration of the contract and during the franchise to be granted to the contractors, they shall have the right to an additional use of such poles and conduits for their commercial wires, and the city is not to grant such uses to any other lighting company upon more favorable terms. The contractors are to retain full title and possession of the plant until the purchase price has been paid.

The other bids were as follows: Union Electric Company, arc lights of 2,000-candle power, $9.90 each per month; incandescent lights, fifteen-candle power, $1.80; thirty-candle power, $2.80. Third Street & Suburban Railroad Company, arc lights, $9.95; incandescent, fifteen-candle power, $1.85; thirty-candle, $2.95.

The whole matter was referred to the city council. The city is now paying about $25,000 a year for electric lighting.

TELEPHONY AND TELEGRAPHY.

POSTAL-TELEGRAPH CO.'S UNDERGROUND WORK IN CHICAGO.

Laying Standard Cable in Chicago.

MANY of the residents of Chicago have noticed that there has been a considerable amount of underground electric work done of late in different parts of that city. One of the most important pieces of work of the kind to be seen recently has been the laying of a new conduit preparatory to the Postal Telegraph-Cable Co.'s removal of their principal office in Chicago from their old quarters on Jackson and Clark Streets where they have been located for several years past, to the fine set of new offices which they have secured in the new Stock Exchange building on Washington and La Salle Streets.

This change rendered it necessary to make some important alterations in their lines, and necessitated their putting in a considerable length of new cable to meet the requirements of their large and increasing business.

There are in all seven 126 conductor, lead covered cables being put down, their combined length being 15,000 feet, and 2¼ inches in diameter. They are drawn into a 3-inch cement lined duct; this is a very close fit, the cable usually being half an inch smaller in diameter than the outside piping.

A smaller cable of 19,000 feet in length is also being used, and the contract for the whole of the work was secured by the Standard Underground Cable Co., 542 The Rookery, Chicago, and is being pushed rapidly forward to completion.

KANSAS CITY TELEPHONES.

An ordinance was introduced recently in the Kansas City upper house, to fix telephone rates at $48 a year for business places and $36 a year for residences. There being a doubt as to the right of the city to fix rates, it was referred to the judiciary committee, which has been advised by the City Counselor, Mr. McDougal, that the city has the power to establish prices. He advises, however, the adoption of a sliding scale for distance.

MUST USE W. U. BLANKS.

The somewhat noted cases brought by J. Kirby against the Western Union Telegraph Company have been decided by the Supreme Court of South Dakota. The decision is made on the test case. Several years ago Kirby wrote out several dispatches on blank paper and the telegraph operator at Sioux Falls refused to take them on the ground that they were not written on the telegraph company's blanks. Kirby insisted that they be received and kept tendering messages in this way until he had some fifty or more. Then he brought suit for $50 damages in each case and won in the lower court. The telegraph company then appealed to the Supreme Court where the decision was reversed. The costs in this case are taxed to the plaintiff, and will amount to something over $1,000.

A STANDARD TELEPHONE CO. IN PENNSYLVANIA.

One of the latest concerns to bid for telephone privileges is the Pennsylvania Standard Telephone Company. When secured it will give the company authority to operate its system at any point within the State. Philadelphia Councils will then be asked for permission to erect a plant in that city to be operated under the patents owned by the parent Standard Company. The object of the Pennsylvania Company will be to organize local companies, which will be licensed under the charter and patent of the general company.

The Pennsylvania Company has been organized with the following board of directors: Richard W. Clay, R. Dale Benson, Harry A. Berwind, John Story Jenks, Nicholas Lennig, Craige Lippincott, Charles Platt, Winthrop Smith, Philadelphia; William F. Armstrong, Henry P. Nesmith, Jr., Otto A. Theurkauf, New York city; George Moore, Braddock, Pa.; E. L. Fuller, Scranton, and George W. Brand, Pittsburgh.

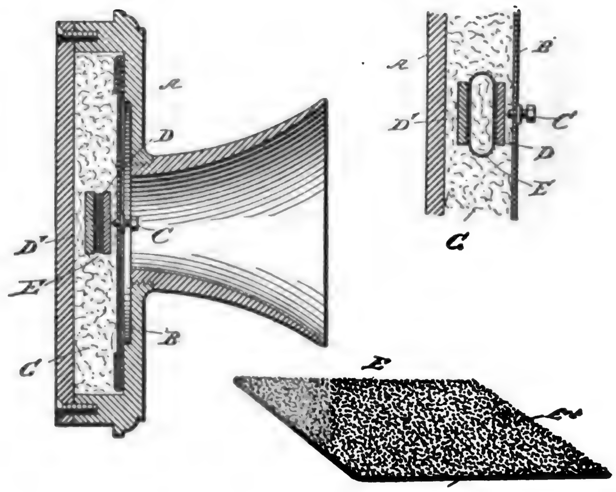
THE LUCAS TELEPHONE TRANSMITTER.

IN order to avoid the difficulties caused by non-uniformity of contact in telephone transmitters employing granular carbon, Mr. I. Lucas, of Passaic, N. J., has devised a form of transmitter illustrated in the accompanying engravings.

The transmitter is provided with the usual casing and a diaphragm, carrying a screw C in engagement with a button D, opposite to which is arranged a rear botton D′. Between the two buttons D and D′ is placed a doubled-up sheet E, consisting of a base E′ of conductive material, such as wire-netting, foil, etc., the sheet being coated on its surface with granulated carbon E², and this surface is in contact with the corresponding inner faces of the buttons D and D′.

The material placed between the two buttons is made in large sheets and cut to the desired form, either in the shape of single discs placed with their bases in contact and with the coating on the outside or in the shape of discs each doubled up, as indicated in Fig. 1, or in the shape of an oblong ring, as indicated in Fig. 2, the granulated coating being in contact with the buttons D and D′, and the space inside of the base is filled in with a soft material G, such as felt or cotton sliver in which the buttons are embedded. The granulated carbon is firmly attached to the sheet of conductive material by an adhesive substance—such, for instance, as collodion—applied to the sheet to receive the granulated carbon in an even layer.

It will be seen that by the arrangement described, the granulated carbon always remains uniformly in contact with the buttons D and D′, notwithstanding that the transmitter may be subjected to jar when located in vibrating buildings—such, for instance, as factories, etc. In transmitters as now constructed, the loose carbon is liable to be displaced between the buttons, owing to the vibrations of the transmitter by external causes; but by attaching the granulated carbon to a sheet of conductive material a uniform contact is always made between the granulated carbon and the buttons.



FIGS. 1 AND 2.—LUCAS TELEPHONE TRANSMITTER.

CLYDE, N. Y.—The Wayne Telephone & Telegraph Co. have completed their line to Rose and begun their regular exchange service at Clyde. The lines will extend to Lyons, Newark, Palmyra and Macedon before winter.

LETTERS TO THE EDITOR.

INCANDESCENT ELECTRIC vs. INCANDESCENT GAS.

There having been considerable said for some time past, in regard to the Welsbach gas burner, I would like to give the experience of our Company, with opposing this very lively competitor. I believe if our electric light men were as full of energy as are the promoters of the "Welsbach," there would be less business done by the gas side of the house.

We have seen some of our lights displaced by Welsbach burners, but, while in Pomona, we still see some small loss, in San Bernardino—at which place some 75 per cent., of our load is used,—we have reinstated all our lost patronage.

In San Bernardino our loss was about 330 lights, 80 being in two grocery stores, the remainder being in the Hotel "Stewart."

The stores returned to electricity, because, unless the gas was very carefully handled, the cost of light was greater with the gas. The Hotel people give a different, and more potent reason.

They found that in an ordinary room, the odors emitted were bad, but on attempting better ventilation, the "mantles" would not stand the cool air.

JOHN E. ADAMSON,
Electrical Engineer,
San Antonio Light & Power Co.
Pomona, Cal.

SAN ANTONIO, CAL., Nov. 5, 1895.

FEATURES OF THE DATA SHEETS.

I wish to let you know how much I appreciate your Data Sheets. They are a splendid idea; but I would like to re-echo the opinions of a number of your subscribers that you publish an extension of the *Index*, so that we can index our notes in the same way.

I have, like numbers of others, several pocketbooks and also a card index, but it is usually more trouble to work a thing out than to hunt it up owing to the want of a good index.

I would like to suggest also that the railroad men have had a pretty good show now, and it would be perfectly in order for the telephone men to get a few sheets bearing more directly on their business. Of course I am speaking for myself, but I think there are lots of telephone men among your readers who would like to see something in their line. Wishing you every success,

J. A. WINFIELD,
N. S. Telephone Co., Ltd.

NEW GLASGOW, N. S., Nov. 9.

ELECTRO-MAGNETS AS TRUSTWORTHY MECHANISMS.

The letter of Mr. Walter E. Harrington, in THE ELECTRICAL ENGINEER of November 13, was very interesting but he clearly misconstrued a statement of mine about the use of magnetic cut-outs on individual cars by saying that we "differ." I simply asked why they were not so used, saying, that if they gave too much trouble for such service, what hope was there for them to meet the varying conditions discussed? There is no reason why they should give "too much trouble" for car cut-outs except bad design and workmanship.

A magnet cannot be adjusted for incessantly varying conditions of which street car practice is full. One will act only when the conditions for which it has been adjusted occur. As a cut-out, it is meant to act only when the current exceeds a specified quantity. When this occurs the magnet is certain to act with a quickness in comparison with which the melting of a fuse is slow.

In such cases as the Chicago Metropolitan Elevated, the B. & O. Tunnel, and others to which he alludes, a fuse would be of no value. It would be so slow in action that the switchboard magnetic cut-out might act first and stop the whole system, the very contingency to be avoided by cut-outs on cars. Hence the magnetic cut-out is essential in a case like heavy railroad work or any other where a circuit breaker controls a large volume of current.

Mr. Harrington speaks of the blistering of the contacts by the arc having been urged as an objection to the automatic magnetic breaker. To weigh such a comparatively trifling matter against so great an advantage as pointed out is extreme folly, for what does a little blistering amount to compared with the safety of apparatus, when difficulties due to it are, in more than one way, easily overcome. His shunt fuse is very ingenious if small enough to melt in an inappreciably short time after the magnet has acted. Again it is very easy to design and adjust interchangeable contacts by which the removed blistered ones may be repaired at leisure in the shop; only a few spare sets of these need be on hand for the largest number of cars.

It will be clear from the above and from Mr. Harrington's letter that we do not "differ" about magnetic cut-outs on cars, but stand firmly upon the same ground.

JAMES H. BATES.

NEW YORK CITY, Nov. 13, 1895.

ACETYLENE AS POISON OR EXPLOSIVE.

I was much interested in the recent article on the effects of acetylene on the human system. When this gas was first brought to the attention of the public, I had occasion to investigate it and have ever since been skeptical of its practical value, on account of the many bad traits it has from time to time developed. Its liability to suddenly and unexpectedly explode and the ease with which a very dilute mixture will support combustion, thus rendering a very small leak exceedingly dangerous, were two of the many characteristics that were found.

It would seem, therefore, that it would be a close race as to whether a small leak would blow a man up before it killed him, or kill him before it blew him up.

Its cost, however, seems to be the main point, for, if it can be made cheaply enough, the defects may be readily overcome.

At the time of my experiments, the cheapest that the calcium carbide could be obtained was fifty cents per pound. As a pound gave five cubic feet of gas it will be readily seen that the gas costs $100 per 1,000 cubic feet. If mixed half and half with another gas so as to reduce it for burning, it would still cost $50 per M. Improved processes of manufacture will probably reduce this, but it will have to be sold *at a profit* for considerably less than one cent per pound before it can compete with present methods.

E. T. BIRDSALL.

NEW YORK CITY, Nov. 15, 1895.

LITERATURE.

The Electrical Transmission of Energy. By Arthur Vaughan Abbott, C. E. New York. D. Van Nostrand Co. 1895. Cloth. 586 pp. 8vo. 289 illus. 74 tables. 9 folding plates. Price, $4.50.

This large, handsome and valuable volume is a credit alike to author and publisher. It is a magazine of data pertaining to the transmission and distribution of current, as distinguished from generation and sources of supply. We cannot too highly praise Mr. Abbott's industry and intelligence in the preparation and arrangement of the contents, and believe he has made one of the most important contributions seen in recent years to electrical literature.

The volume is divided broadly into distribution, the properties of wire, construction of aerial circuits, underground circuits, instruments, measurements, conductors in continuous and alternating work; series and parallel methods; long distance transmission, cost of production and distribution. There are proper subdivisions under these heads, and all the paragraphs are duly marked out and classified. In general, we like the plan of the book, which would be hard to improve on; but it seems easy to detect in some places the author's natural difficulty in determining where "transmission" ends and "distribution" begins.

Mr. Abbott has covered so much ground, and mastered so many details of his vast subject, we hesitate to suggest additional matter. It seems to us, however, that it might have been well to have included a few more typical railway conduits, for there lies a field destined to rapid growth. There is also less than one might expect on glass, porcelain and other insulators, or on insulating materials and compounds; all of which are vital elements in the success of any transmission. More surprising than all is the omission of such modern and scientific methods of interior wiring as conduit systems. It is possible that Mr. Abbott may not consider these within the scope of his book, but we note that the insurance rules on the subject of interior conduit wiring are given. By the way, cleat work is indexed as "clear." It would perhaps have been well to point out that, unfortunately, there are divergences between the rules of the National Electric Light Association and those of the insurance bodies; a fair inference from Mr. Abbott's book being that they are, as they ought to be, identical. We note also that while the Thomson wattmeter is given in the section on instruments, the Edison meters in such widespread use are omitted. This may be intentional and not wrong, although if Mr. Abbott had been brought up in the field of light and power he would probably have felt it incumbent on him to find place and mention for them.

Mr. Abbott has given an admirable résumé of long distance transmission work. His reference to the Pomona, Cal., plant states the distance as 16 miles, whereas the energy is delivered also at San Bernardino, 28½ miles. The note on Niagara remarks that the low frequency employed will not permit of satisfactory lighting without the interposition of motor transformers. This is true, but the low frequency was adopted for just that reason and end, the Tesla two-phase system being distinctly adopted for its power *transmission* virtues, and the questions of distribution being left for rotary transformers and other kindred devices, dependent upon the nature and bulk of the work to be done at the point of delivery.

Aside from these and a few other minor criticisms, we see little in this useful book but to praise and recommend.

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CONTENTS.

IS THE PATENT SYSTEM ANY GOOD?

THE fate of the Sawyer-Man patent or that on the Brush double carbon arc lamp, cannot but cause people to wonder whether patents have much real value. We would not undertake to state exactly how much money has been spent to sustain those two patents, but probably $250,000 would be a safe figure. Yet at the present time, neither is worth anything to its owners, but represents dead loss. In other words, the U. S. Patent Office set its official authority upon certain ideas as being new, original and patentable, but the owners of this intellectual property have from the first had to fight for it and the courts now tell them that their investment and trouble is a waste of time and money. Look at it as one may, such a state of affairs cannot be regarded as at all satisfactory.

We print this week the remarks of Mr. Edison upon the situation that such decisions develop, and from which he believes himself to be an unusually heavy sufferer. He does not mince matters. "Our patent laws" he says, "which as interpreted by the Courts, encourage perjury and put a premium on fraud, are worse than a farce." He said he would have been a gainer if he had never taken out a patent, and he advises young inventors to stay away from the Patent Office, the path to which he once kept hot with his incessant footsteps.

As though this serious impeachment by a leading inventor were not enough, we find attacks on the Patent Office from the diametrically opposite standpoint—that of the public and consumer. At the recent Montreal Convention of the American Street Railway Association, the Committee on Patents reported as follows, in urging co-operation for defence of patent suits. "Since the adoption of electricity as a motive power, we find that the number of patented articles in use on street railways has increased wonderfully. *We are confident that a large number of these patents is worthless*, and will not hold water." As a reflection on the system under which patents are issued, the reproach could not well be stronger. Yet when the Government is itself attacking, in the Berliner case, the validity of one of its own patent charters, we do not see how the language can be treated as so unfair as to be unworthy of notice.

But what is to be done about it? Mr. Edison suggests this remedy: "The court should give the man who first secures a patent or first makes application for it, the benefit of the doubt until the question of priority has been finally passed upon or settled." This seems a rather rough and ready method, but, after all, is it not better than the present sophisticated way, by which awful injustice is often done, and capital often kept back when it would otherwise be used for industrial advance?

THE GENERAL ELECTRIC PRESIDENCY.

THE one new thing in all the rumors current about the General Electric Co. is the story that Mr. C. A. Coffin is going to give up the presidency to Mr. Morgan and has sent in his resignation in order to join Mr. McDonald in the Fort Wayne Corporation. We dislike to spoil a sensation in these dull times, but we must say that this story appears to us altogether the worst of a poor lot. Just to add our quota

to the reports afloat, we venture to assert very firmly and positively that Mr. Coffin has not sent in his resignation and will not for the present resign the presidency. We do not, however, underwrite his prolonged tenure of office; that would be too much in the nature of Wall Street gambling.

UNTRUSTWORTHY ELECTRICAL MECHANISMS.

Ever and anon a note of warning or of condemnation is sounded against the employment of certain much used devices in electrical work, but it has been observed not infrequently that the substitutes suggested to displace the older forms possess disadvantages of their own which more than counterbalance the defects of the more familiar types. There is perhaps no mechanism more universally employed in electrical work than the electro-magnet and it would therefore seem hardy to impugn its reliability; yet in recent letters appearing in our columns, Mr. James H. Bates condemns its use for a number of purposes to which it has been applied, more particularly in connection with conduit electric railway systems. Incidentally he also refers to its lack of reliability in other branches, such as that of telegraphy, and urges that for conduit railway work a mechanical switching device alone can fulfill all the varying and variable requirements of practice. It seems worth while to dwell on the point here raised and to seek to determine if the indictment is justified.

A survey of the work accomplished by the electro-magnet would seem to demonstrate that as a prime mechanism, pure and simple, it leaves little to be desired as regards faithfulness and accuracy of work. The trouble that has been developed occasionally in the past may almost invariably be traced to bad auxiliary mechanism, which has caused the condemnation of entire classes of apparatus embodying electro-magnets in their construction. We need only refer to the early use of electro-magnetic cut-outs in electric lighting work and their abandonment in favor of the fuse. Yet it is doubtful if a more untrustworthy device can be found in the whole range of electrical applications, in proof of which we need only refer the reader to the elaborate tests of Prof. W. M. Stine, and associates, given in their Institute paper now appearing in our columns. As a result we note a decided tendency torevert to the "old reliable" electro-magnetic cut-out, and this tendency has made itself felt perhaps most markedly in electric railway work within the station as well as outside of it. After all that can be said against the electro-magnet, we believe it will still be conceded that so far as trustworthiness is concerned, it *can be made* to be as nearly absolute in its action as any other practical working device. This accuracy, however, requires care in manufacture, and the cost of obtaining this accuracy has alone, we believe, stood in the way of the more general employment of electro-magnetic devices in the place of less expensive apparatus. True, this consideration is not to be lightly brushed aside, especially when it involves an important detail of a rapidly growing art; but viewing the question from the standpoint of reliability, first and foremost, the electro-magnet will undoubtedly stand the test.

Apropos to the same subject is the comment recently made by a German contemporary on the inadequacy of the present types of lightning arresters for power and lighting circuits. Our contemporary is of the opinion that progress in this particular direction is hampered by the fact that the present types are the result of laboratory experiments on disruptive discharges; but that if artificial lightning could be produced the knowledge to be gained by its aid would be of great value in the design of apparatus intended to protect circuits from atmospheric electric influences We heartily second its proposal that the question be taken up by the various electrical bodies acting in concert; its importance cannot be too strongly urged.

It seems rather late in the day to place arc lamps in the category of untrustworthy mechanisms, but if we are to believe certain figures about Detroit that are now being circulated in a congratulatory way by the friends of municipal plants, the arc lamp is a poor creature and sadly fallible. Detroit has a fine new city plant, and it is stated that in October out of 1470 lamps only 152 were "out," for a total of 1040 hours. Yet in October, 1894, when the bad, bad contractors were doing the work with 1279 lamps, 1196 of those were out for a total of 6746 hours. In view of the fact that the city was putting in a plant of its own, we wonder the contractors who were being confiscated had any lights going at all; and the familiar troubles of that time may explain the mystery of so abnormal a delinquency. But the new figures do not strike us as revealing any very superlative efficiency. We have before us at this moment the figures of a New England city, and find that in October out of 594 lights furnished by the local company, the average for the last week of the month was 2.1 lamps "out" all the time, or $\frac{1}{4}$ of 1 per cent. of the total. That seems to be about normal for any self-respecting private plant, especially when we remember that "rebates" are inflicted pretty vigorously. We would like to know from some of our readers what they consider a fair allowance, and whether a good arc lamp decently treated will not prove to be a trustworthy electro-magnetic mechanism, within $\frac{1}{4}$ of 1 per cent. of perfection. Of course, we exclude from our survey such "outs" as may be due to accidents like that in the New York Brush station last week. The explosion of a main steam pipe is obviously not to be charged up against an arc lamp, but comes under the head of other untrustworthy mechanism that is not electrical.

DELANY TOO SPEEDY.

VARIOUS cities are now discussing their merits as a place to hold the next National Conventions, and San Francisco is eager to get the Republican gathering. But one of the leading objections is that the telegraphic facilities of the city are not adequate. The local *Call* says: "There is a striking oddity in the fact that the main objection to holding the National Convention in this City is the alleged inadequacy of the telegraph system. It would appear from this that the age is too speedy for electricity, that everything has got ahead of it and that lightning cannot keep up with the procession." We recommend this pithy comment to our telegraphic friends, and especially to Col. Clowry, of the Western Union, who says that Delany's method of transmission is too fast for him, and that he wouldn't know what to do with it if he had it. How a *telegraph* service can be too speedy, is not quite clear; but one of these days the fact will dawn on some people that the telegraph can be too slow.

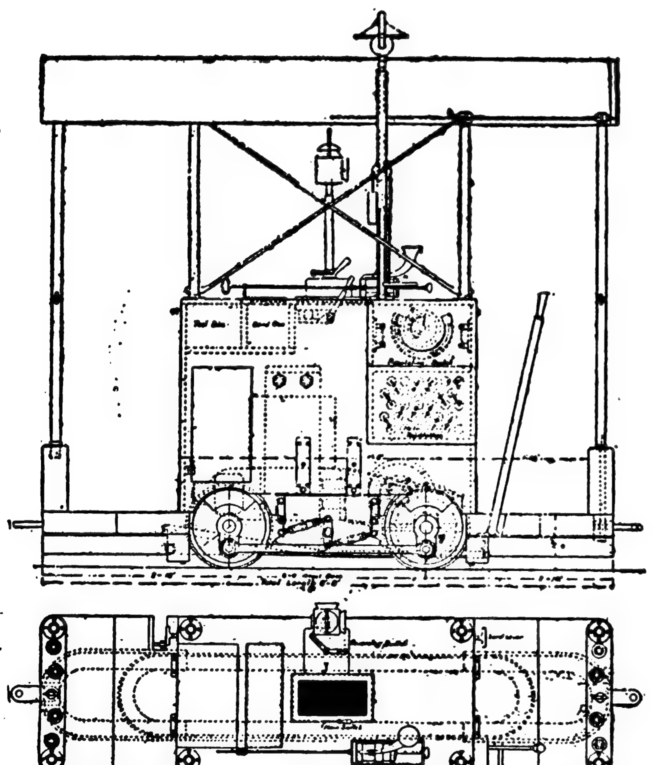
ELECTRIC TRANSPORTATION DEPARTMENT.

THE ELECTRICAL PLANT AT THE WATERLOO AND CITY RAILWAY, LONDON.[1]

BY R. W. WEEKES, WHIT.SCH., A. M. I. C. E.

This railway, which is to provide the much-needed communication between the Mansion House-circus and Waterloo, London, is being rapidly constructed by Messrs. J. Mowlem and Co. The line is being excavated on the Greathead shield system, and will eventually be worked electrically. It is seldom, however, that electricity has been so extensively used as an aid to the contractor in executing railway work. Messrs. J. Mowlem and Co. obtained the contract for carrying out the work for the Waterloo and City Railway Company. Having seen from previous experience the possibilities of electric traction, they decided to adopt it to assist in the excavating process, and retained Messrs. Bramwell and Harris to draw up a scheme for their electric lighting and traction work.

The soil dug out is loaded into skips, which stand on low platform trucks running on rails of 18 in. gauge. These skips are coupled together, and the loaded train is hauled to the shaft by electric locomotives. Steam cranes on the staging raise the skips to the surface and empty the soil into barges alongside. It is in this that the position of the works is so advantageous. The whole of the transport, both of the excavated material and iron lining, etc., for the tunnel can be effected by water. This greatly facilitates and cheapens operations. The whole of the boilers and machinery for compressing air and for generating electricity is placed on the staging. The consulting engineers, Messrs. Bramwell and Harris, fixed the voltage for lighting purposes at 100 volts, and adopted 200 volts as the pressure for traction purposes Hence, they arranged that at first two shunt-wound dynamos,



FIGS. 1 AND 2.—SIEMENS LOCOMOTIVE FOR HAULING EXCAVATED MATERIAL, WATERLOO AND CITY RAILWAY, LONDON.

each giving 112 amperes at 100 volts, should be used, and should be run in series for driving the locomotives.

The design of the locomotives has varied considerably, as improvements have been suggested from experience gained in work. The consulting engineers specified that the locomotive should be capable of drawing some five tons on the level at a speed of from six to seven miles per hour, or up a grade of 1 in 60 at a speed of three miles per hour. These requirements have been most amply met by Messrs. Siemens Bros., as the speed of a trip when the load is eight tons, averages 9¼ miles per hour with a grade of 1 in 800. When running light over the same portion of the road, a speed of 12.6 miles per hour was easily obtained. Three locomotives have been supplied by Messrs. Siemens Bros. and Co. up to the present. The first one was started on February 25, and has since run for some 200 days of 24 hours without repair and with only one set of brushes. For 18 hours a day the locomotives work at full pressure. The second locomotive was started on May 4, and has been at work ever since. The third was started on October 1, 1895.

The narrow gauge of the line and the necessity of having one

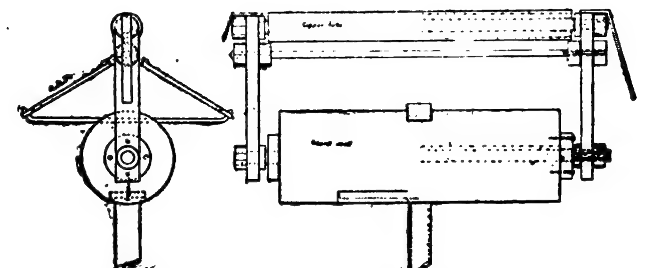


FIG. 3.—DETAILS OF TROLLEY CONSTRUCTION.

siding at the working face and two under the shaft seriously cramped the design. The actual width available, owing to the circular form of the tunnel, is a little over 10 ft., and the width of the locomotive had to be considerably under one-third of this to enable it to safely pass places where skips are standing on the sidings at either side of the centre line of rails. The illustrations (Figs. 1 and 2) show the second of these locomotives, in which the frame was lengthened to give standing room at each end. The motor, which is of the Siemens H. B. 8.10 type, has been most carefully protected against damp. The series coils are surrounded by metal cases, which are hermetically sealed. The armature is also surrounded by gunmetal castings, handholes covered by slides being provided for the inspection and adjustment of the brushes.

The brushes are made of copper gauze, and are placed end on to the commutator. They slide in rectangular guides, and are held against the commutator by springs. The clearance between the brush holder guide and the commutator is barely ⅛in., so that the brush does not burr over. This construction has worked most satisfactorily, and enables the motor to run in either direction.

There is no provision made for varying the lead with the direction of rotation, the brushes being fixed on the centre line. The gearing connecting the motor to the axles is a double-reduction. A bevel pinion of phosphor bronze keyed on to the armature shaft outside the end bearing, was found to be in perfect order, the surfaces of the teeth being polished and glazed. The wheels of the locomotives are coupled by connecting-rods.

In the first design the starting and regulating switches were connected to the brake levers, so that the locomotive could be driven from either end. The forward motion of the brake lever first took the brake off, and then switched the current on. This method has, however, been abandoned, and the brake lever has been replaced in the last locomotive by screw gear, which is more satisfactory. The reversing switch is geared to the red lamp on the locomotive, so that it always turns the light to face in the direction in which the train is moving.

For several months a double overhead overrunning trolley system was used, but this gave so much trouble that the single overhead circuit with earth return was adopted last June. With the single-wire system, owing to the limited height available and the dip necessary when going on to the side roads, and also to the fact that time could not be allowed to reverse the lead of collection when reversing direction, there was some difficulty in designing a suitable collector. Another special condition which added to the difficulty was having to cross under the shaft where it was impossible to carry the trolley wire. Mr. H. Allen, the electrical engineer in charge of the work for Messrs. Mowlem & Co., has designed two forms of collectors to comply with these conditions. The first is the telescopic pattern shown diagrammatically on the car in Fig. 1 and in detail in Fig. 3. The vertical pressure of the collector against the wire is maintained by the action of weights, whilst india rubber springs allow the collector to take a certain amount of lead in whichever way the locomotive is running. The other collector is always inclined at an angle to the wire, but

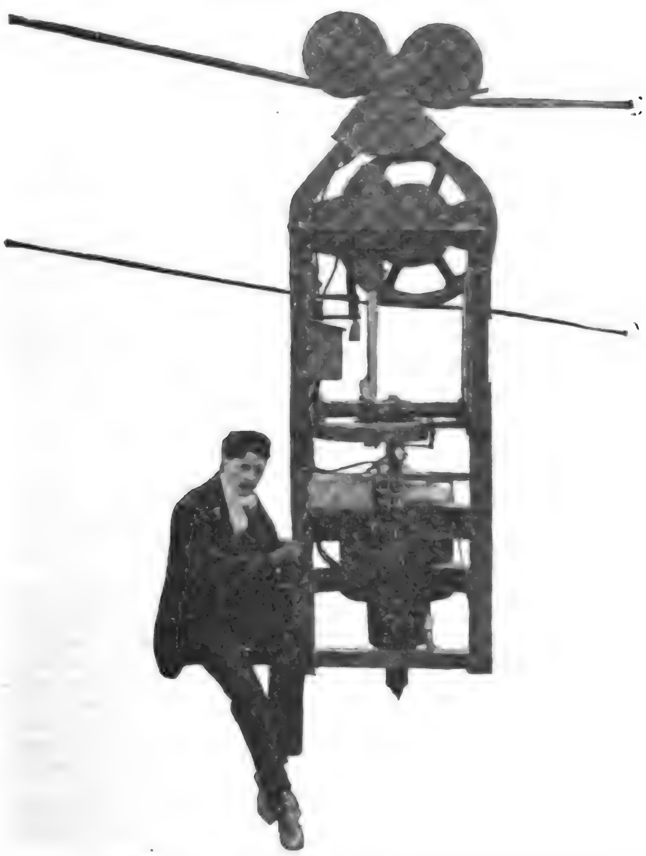
1. Abstract from the London *Electrical Engineer*.

when the locomotive is moving in one direction the angle is against the motion. In this collector, again, the pressure is maintained by weights. The actual contact with the wire is effected in both cases by a 2 in. copper cylinder some 18 in. long, which allows ample margin when taking the points. The trolley wire is of 0.25 in. diameter hard-drawn copper, held in "ears," which grip it by means of two set screws in such a way as to leave a clear section of wire. About 1½ miles of this is now fixed in the two tunnels.

At the compressed air faces, the Greathead shield is moved forward by electric motors driving three-throw pumps by means of worm-gearing, which gives a pressure up to 1,700 lbs. per square inch. These pumps are placed on rails and fastened by a wire rope to the "shield," so that they advance with it.

CANAL IMPROVEMENTS AND THE LAMB MOTOR ON THE ERIE CANAL.

We have recently published articles dealing with the very interesting and encouraging work done by Mr. Richard Lamb in the application of electric power to the haulage of boats on the Erie Canal. The experiment has, from its vast importance, been worthy of the attention bestowed upon it everywhere, and we are glad to learn that the system has won the official and recorded approval of Mr. Aldridge, superintendent of public works, and



THE LAMB MOTOR-TROLLEY ON THE ERIE CANAL AT TONAWANDA.

Mr. Hannan, superintendent of canals. Steps are now being taken actively for the equipment of the whole of the busy section of the canal from Buffalo to Tonawanda, and it is even said that lines may be set up on both banks in order to cope with the heavy traffic.

Our illustrations have already dealt with the Lamb modus operandi, but we are now able to print a very clear and large picture of the motor, whose novelty of arrangement is well shown. It will be remembered that in canal boat towing, the cable is placed on the inward side of the towpath. The bearing cable is strung 16 feet above the ground, and 8 feet below it is the traction cable, of ⅝ inch diameter. The motor truck has two deep grooved wheels, with a horizontal axle between them and below their centre line. From this axle is suspended a hanging frame having attached to it an elliptically grooved sheave, revolved by a worm or wedge gearing driven by a 15-kilowatt motor of the Storey circular type with vertical shaft; all attached to the swinging frame of what may be termed the car. The ⅝ inch cable is wrapped three times around the elliptically grooved sheave, and is both wound in and paid out as the motor revolves, thus pulling along the car and whatever may be attached for haulage. In this manner, the motor gets its tractional friction independently of the weight of the apparatus. It might seem desirable to have the motor travel on straight lines, such as rails, but Mr. Lamb considers that the advantages of flexibility in the cable are more than compensating for any extra use of current, if such there be.

As has been stated before, the current is returned through the traction cable which is grounded at intervals, giving a combined ground and metallic conductor from the return current. A five hundred volt current is used. It is taken from the main cable through the wheels, thence through the axle to the axle-box of the hanging frame, where an insulated copper wire connects it with the rheostat. The return is through the axle of the elliptical grooved wheel; thence on to the ⅝-inch wire to the brackets; thence through a wire to the ground; thence to the terminal of the generator. When the motor reaches the bracket the traction cable is lifted from the saddle momentarily, and the car can take a new course. Hence it is not limited to operating in a straight line. The saddles are made so that the wheels leave the cable and ride over on their flanges in the channels of the saddles made for straight line or right and left deflections. The main cable is insulated at the brackets by insulating material placed between the saddle and the bracket, and the current is prevented from passing down the frame of the motor by insulation at the point on the frame where the axle-box joins the frame proper. The points of insulation are provided in their construction with hoods to shed water.

The worm or wedge gear used, differs from an ordinary worm gear in that it has more than twenty times the bearing surface of an ordinary worm and wheel, moves two teeth of the gear wheel at each revolution of the worm, and works on the principle of a wedge rather than an inclined plane. The worm gear especially made for this electric motor, is designed to work both ways, and has ball-bearings at either end of the worm, to lessen the friction and thrust. The gear wheel, worm and ball-bearings are encased in a jacket filled with oil. Thus the minimum loss in power is effected between the electric motor and the elliptical grooved wheel. The gearing is necessary in order to lessen the speed, as the electric motor is run at 1,240 revolutions per minute.

The rheostat is made to carry the current through it as well as to regulate the speed and reverse the current, and has an automatic switch. Four insulated copper wires armored with steel wire form the cable that conducts the electricity from the bearing cable to the rheostat on the boat and back to the motor, and at the same time acts as the tow line. The upper end is clamped to a ring that runs on a traveller situated on the frame of the motor about the lower part of the elliptical grooved wheel. A long steel clamp, with toggle joints, is used to hold the towing cable at any point desired, and has a ring in one end to which is attached a short length of rope, which is made fast to the sampson post of the boat. The end of the towing cable is carried to the rheostat on the boat, where it is coupled to a similar piece of cable wired to the terminals of the rheostat. The coupler is designed so that it is impossible to join other than the right wires together, and the contact is made quickly and securely.

When a motor is to be run without any boats in tow, its rheostat and conducting-wire tow line is placed upon the motor, and a driver seated on a seat on the electric mule operates the same.

Mr. Lamb informs us that the quantity of current used can only be called "disappointingly small," indicating either that a lighter motor can be used or that heavier loads can be easily hauled. Mr. Lamb is now engaged making dynamometric tests of the work done.

The recent vote of the State has been in favor of the appropriation of $9,000,000 for improving and deepening the canals, and the work is to be proceeded with at once. The effect of deepening the canals, will, of course, be to render the use of electricity much more economical and advantageous, every additional foot of water lessening the power required and permitting a higher speed. About $4,000,000 of the $9,000,000 is immediately available, and the bonds will probably issue by the end of the year. Within three months after issuing the bonds the law directs the Superintendent of Public Works to proceed to enlarge and improve the Erie Canal, the Champlain Canal, and the Oswego Canal, the improvement to the Erie and Oswego Canals to consist in deepening the same to a depth of not less than nine feet of water, except over and across aqueducts, miter sills, culverts, and other permanent structures, where the depth of the water shall be at least eight feet, but the deepening may be performed by raising the banks wherever the same may be practicable; also the lengthening or improving of the locks, which now remain to be lengthened, and providing the necessary machinery for drawing boats into the improved locks, and for building vertical stone walls where, in the opinion of the State Engineer and Surveyor and Superintendent of Public Works, it may be necessary. It is not unlikely that the improvements of the Canals will include other applications of electricity and that next spring, the electrical regime of canal operation in New York State will make a definite and auspicious beginning. The work on the Buffalo-Tonawanda section of the Erie Canal will be the first large piece of the kind, comparing in that respect with the historic and successful Sprague railway work at Richmond.

A NEW FACTOR IN BRAKING CARS.

BY

There has been unusual attention paid to the problem of braking street cars, within the past year. The evolution of the electric car has been so rapid and startling as to seriously interfere with the perfecting of certain parts of car equipment.

Particular attention has been paid to the improvement of the electric motor in its application to street car propulsion, and it is not surprising that certain other essentials in road equipment have not received such attention as they would have had, had more time been available.

The three leading factors in car propulsion are the motors, the wheels, and the brakes. The former have reached a satisfactory stage; they are commercial and standard. In the development of motors there has been special attention paid to increased speed. We now find motors averaging fifty H. P. each, and they are being wound to permit of a speed of sixty miles per hour. This, too, not for an occasional run, but for *everyday* service over certain portions of the route.

Unfortunately, these heavy motors do not contain within themselves *the means of checking the speed they have generated.* It is obvious therefore, that there should be adequate protection through the aid of some apparatus *wholly disconnected from the propelling power.* It is here that the air-brake comes into play! Whether the air-brake receives its power through the working of a compressor on the car axle, or by having an independent motor operating the compressor, the desired object is the same in either case; namely, the storing of compressed air in tanks (more than capable of resisting the pressure) which, by means of proper valves and regulators, admit of instantly furnishing air to the brake-cylinders, for anything from an *ordinary service to a full emergency stop.*

It was comparatively easy to apply air-brakes to cars making a maximum speed of twenty miles per hour. This was successfully done and is being done in a number of places with entire satisfaction; but with the advent of increased speeds and heavy rolling stock, new factors confront the air-brake manufacturer and he must meet these if he hopes to be permanently successful.

It would not be very surprising if, within the next two years, electric cars on interurban roads should attain to a speed at the rate of 100 miles per hour. In recent important railway construction, the weight of rails, solidity of road bed, and other features, lead to the belief that this foundation has been laid in order to secure a speed which will leave steam trains behind.

The ultimate success of certain electric roads will hinge largely upon their ability to maintain a higher speed schedule than has proved practicable on the steam roads which they parallel.

There seems little doubt that the street car air-brake will be the *last and only resort of managers operating cars at these unusually high speeds!*

Much has been said about the electric brake, and several conscientious workers are striving to perfect electric and magnetic brakes which are to answer all requirements. "A chain is no stronger than its weakest link," and it must be admitted, in fact *is* admitted even by these workers, that they have *not* reached the commercial stage.

The street car air-brake dare not be a scientific toy. It is absolutely essential that it shall at *any* and *all* times be positively reliable. There must be no deviation from this requirement.

If the motor becomes disabled, no worse harm results than stalling of car and inconvenience to passengers, but if an air (or any other kind of brake) fails to respond at a critical moment, much more serious results will follow. In the majority of cases fatalities and loss ensue.

In considering the factors in braking, many parties lose sight of the fact that, not only should the brake be relied upon to protect passengers inside the car, and the car itself, but, what is *fully* as important, the brake should protect *outsiders* also. It is as important to avoid running over pedestrians and into vehicles, as it is to prevent the car from crashing into a gate crossing or the car immediately ahead of it.

If there was a certainty that the air-brake would receive proper attention from motor and grip-men, the problem would be immensely simplified. The fact is, while motors receive a fair amount of attention, air-brakes are often utterly ignored.

If an oiler neglects the motor, trouble follows, and his neglect renders him liable to discipline. If he neglects to lubricate the air-brakes, the omission is more difficult of detection, and, *what should be charged to his neglect alone,* is invariably laid to the air-brake. The art is "young" or this would not be so.

The time has come when this matter of lubrication and attention must receive greater and proper consideration.

In portions of Europe it is the rule always to inspect a car at the end of its run. It is not allowed to leave the shop until motors have been gone over and anything loose has been tightened. If but a portion of this attention were paid to apparatus in this country, better results would appear.

What is true of air-brakes is true of other brakes. Any slack should be taken up and loose bolts should be tightened. Failure to do this often causes accidents and damage.

We have become accustomed to *trains* (instead of single motor cars), and in this connection the air-brake speedily demonstrates its superiority over any other form of brake. By means of the air-brake the driver controls his entire train and all extra brakemen are dispensed with. They generally try to qualify as motormen for air-brake cars.

There is no electric brake which it is claimed will handle trailers. If a successful electric or magnetic brake can be produced, it must be adapted to handle trailers or extra cars as perfectly as it should brake motor-cars!

It is claimed that a very few types of mechanical brakes can be applied to trailers, but unfortunately, so much room is required on the motor-car axles for the brake rigging, that there is no chance to mount the mechanical brakes on the average motor-car, especially as only few cars now have free axles. However well such brakes could be applied to cable cars, they *cannot meet the situation on electric cars.*

In the only really successful street car air-brake on the market, provision has been made for self-oiling bearings and the apparatus is so constructed as to resist even willful misuse.

It's bad enough to have an air-brake entrusted to a green motorman, but this is not the worst danger to which an air-brake is exposed.

There are cases on record where passengers have deliberately tried to injure the mechanism out of pure maliciousness. They have carried away wrenches and even the controlling handles while the motorman was not watching, have cut hose, etc.

The motormen themselves are elated over the air-brake, for it has emancipated them from needless and severe work. It relieves them of the terrible strain they formerly were under and leaves them in better physical and mental condition than was possible before its advent. If they were allowed to oil and inspect the air-brakes the problem would be easy of solution. But they are not allowed to attend to their apparatus and we must therefore rest in the hope that ere long managers will insist that oilers or inspectors will be more careful in their attention to such an important factor in railway practice as the street car air-brake has become.

ELECTRIC RAILWAYS IN CHICAGO.

BY

The electric railway has taken Chicago by storm, the rapidity of its progress almost surpassing belief. Two years ago there was not a single electric road in the city, not any reasonable prospect that there would ever be one, in view of the deep-seated prejudice against the "deadly trolley," sustained and fostered by the public press. Now the electric cars are running in every direction, and new lines in all stages of construction may be seen on every hand. More than two-thirds of these lines are in the West and North Divisions, where a year ago there was not a single electric car running.

What has wrought this wonderful change? Popular opinion says: "Money corruptly used." And popular opinion may be more than half right. Be this as it may, electric men welcome the new era, and the people, no longer terrified by the "deadly trolley," will never consent to return to the slow-going horse-cars, after being whirled along at the rate of 12 to 15 miles an hour by the electric cars.

With the exception of the "Metropolitan Elevated," these electric roads are all constructed on the overhead trolley system, and are substantially built and equipped in accordance with the very latest and most approved methods. The old, light rails of the horse-car lines have been replaced by the new style, heavy rails, properly bonded, both in the re-constructed roads and the new ones. The poles are of steel, and are placed on both sides of the street, except in a few instances where the owners of abutting property have insisted on a single, central row with double brackets, as being more ornamental.

The cars in the West and North Divisions are lighted and heated, as well as run by electricity; and the electric heating, on the lines put in operation last winter, was entirely satisfactory. The South Division lines tried electric heating, but abandoned it as too expensive, the electric current for this purpose having been obtained from the Chicago Edison Co., while all the other lines generate their own current for heating and lighting, as well as for running the cars.

There are no electric lines yet constructed in the great central business district of the South Division; but it seems evident that

this section also will soon have electric cars instead of horse cars, as the first ordinance to this end, permitting the construction of a trolley line on South Clark street, north to Washington street, in the very centre of this district, passed the Common Council by a large majority Nov. 11. Within the last two weeks the construction of a trolley line on Indiana avenue, in the most elegant residence district of the South Division, has been begun, and the line will soon be ready for the cars.

It is safe to predict that within less than two years there will not be a single horse-car left in Chicago, and also that the cumbersome, power-wasting, uncertain cable system must also depart. Already the West Division Railway Co. has constructed a trolley line over one-half of its Milwaukee avenue cable line, ostensibly for the operation of its night cars, but really, no doubt, to replace this part of its cable line, as an experiment which, if satisfactory, will result in the electric re-construction of all its cable lines.

The "Metropolitan Elevated," a West Division electric road, constructed on the same plan as the "Intramural" road, at the World's Fair, with a third rail as a conductor and the sliding shoe as a collector of the electric current, has been in successful operation since last May. It is seven and a half miles long, including its three branches. Its cars are lighted and heated, as well as run, by electricity, and it is doubtless the best constructed and equipped elevated road in the world. THE ELECTRICAL ENGINEER has already described it very fully.

The Lake Street Elevated is also preparing to abandon steam for electricity, and the "Alley L," as it is commonly called, will doubtless soon make the same change. The "Northwestern Elevated," now in process of construction, will also use electricity; as also the "Union Loop," an elevated road now being constructed in the central business district, to be used in common by all these elevated roads.

A FLY WHEEL ACCIDENT AT ALBANY, N. Y.

A special dispatch from Albany of Nov. 12 says: A gigantic fly wheel burst in the power house of the Albany Railway Company, on Lower South Pearl Street, late this afternoon. Two houses, one of them two blocks from the power house, were wrecked. Four persons who were in a saloon opposite the power house were injured, one of the pieces of the wheel tearing out the whole front of the saloon, and another piece the whole upper portion of the house. One of the injured men died in the hospital.

No one in the power house was hurt. The house of Mrs. Elizabeth Metz, two blocks away, was wrecked by a flying piece of the wheel, eight feet long and four feet wide, which descended in a slanting course, striking the top of the house and tearing out a whole side. A section of the north side of the power house, twenty-five feet wide and extending from the ground to the roof, was torn out, and one of the engines and a generator were demolished. The damage will aggregate $30,000.

Travel on the lines of the railway company was suspended for a couple of hours.

ELECTRIC TRACTION IN PENNSYLVANIA MINES.

Mr. Frederick J. Platt, the manager of the Scranton Electric Construction Co., writes as follows, under date of Nov. 1, to the Scranton *Tribune:* In an article in your issue of Thursday morning, this week, entitled "Mine Mule Superseded," you make a few statements which we beg leave to correct. You state that "the electric locomotive recently installed at the Bellevue mine is the first one to prove successful, not that the system is defective, or anything like that, but wherever these machines have been introduced some hitch or another appears to have attended the test, necessitating a re-shipping of them back to the factory for overhauling."

We wish to state that prior to the installation of the Bellevue plant we have equipped three different mines in this region with electric locomotives, which have proven entirely satisfactory from the very start; in fact, we have exceeded our guarantee in every case by hauling larger trips than our contract called for. We installed at the mines of O. S. Johnson, Green Ridge, an electric locomotive which has been running continuously for eight months and has been giving entire satisfaction. This locomotive is working on one of the most crooked gangways in this section, and is also hauling loaded cars out of a 7 per cent. dip. It would require thirteen mules and eleven driver boys and runners to equal the output of this locomotive.

At the Ontario tunnel of the New York and Scranton Coal Co. in Peckville, the locomotive which we installed last February has not lost fifteen minutes since it was started. At this mine it would require nine mules and six boys to equal the output of the locomotive. Another locomotive, at the Sturges shaft of the New York and Scranton Coal Company, at Peckville, has been in successful operation for a few weeks, and has not only replaced a number of mules and boys, but will enable the company to increase the output at that shaft very materially.

We write this to correct the false idea expressed in a portion of your article and to impress it upon the public that electric mine haulage is not in its infancy, but is an established, reliable and efficient system of hauling coal on our underground roads.

A MYSTERIOUS EXPERIMENTAL CAR BURNED UP.

An experimental electric car about which massive secrecy has been maintained had a trial trip last week, and then in some unexplained way, the concealing shed and all it harbored went up in smoke. The burned property belonged to the New York and Putnam County Railroad, and stood a short distance north of the Van Cortland Park station. The lower end of the long shed was occupied as a shop, and there electricians and car builders have been experimenting for several months with the new electric motor car, with a view to finally adopting it for passenger traffic on the road. The middle of the shed contained eight cars loaded with lumber and coal.

The electric car which was destroyed had been under course of construction for several months, and was very near completion. It was taken out on a trial trip on Tuesday of last week and was run up and down the tracks. The car was to have been exhibited in a few weeks, and invitations had, it is said, been sent out to railroad officials all over the country to witness the formal trial. The car was reported to be the invention of the company, and was guarded zealously. The watchmen about the shed were so strict that the police dubbed the car "the Dark Secret." The car was valued at $6,000, and the secret of its construction at many thousand more. The damage to the shed and freight is estimated at $4,000.

A "BICYCLE" ELECTRIC FOR LONG ISLAND.

The State Board of Railroad Commissioners met last week at the Chamber of Commerce in this city to hear the application of the Kings, Queens and Suffolk Railroad Company for permission to construct an elevated electric railroad through Long Island. John Sabine Smith appeared in behalf of the applicants, with proof of publication of the application for the franchise, a map of the proposed route, and a petition signed by hundreds of persons asking for the railroad. The route over which it is proposed to build the roads is from the present terminus of the Kings County Railroad through Liberty Avenue to the Aqueduct station, to the head of Jamaica Bay, and thence direct to Far Rockaway village. The bicycle road recently in operation at Bellport, L. I., is to be practically the model of the proposed road. The rate of speed on the road is to be from fifty to sixty-five miles an hour. In answer to a question by Mr. Kelly, Mr. Denton, the President of the petitioning company, said that some time the company expected to run its cars at a speed of 100 miles an hour.

A BUFFALO-NIAGARA TROLLEY NETWORK.

Plans are now maturing for the construction by New York and Philadelphia capital of a system of electric roads to connect Buffalo, Niagara Falls, Tonawanda, Lockport, and neighboring towns for freight and passenger traffic. Power will be furnished by the Niagara Falls Power Company. Surveys for about one hundred miles of road are, it is said, already complete, and rights of way have been secured. The Niagara current is now being delivered to the Buffalo-Niagara trolley road through a rotary transformer, as far as North Tonawanda.

THE BUFFALO TRACTION CO.'S PLANS.

The above company, which includes Tom Johnson, John K. Page and Herbert P. Bissell, proposes to give Buffalo a large new trolley system, the track to be laid with 95 pound grooved girder rails laid on steel ties in eight inches of cement, using Stephenson cars eight inches wider than those on Broadway, New York. Judged by the averages of other cities, Buffalo with its 340,000 population ought to have 50 or 60 miles more of street railway. It now has 148 miles. The proposed new system will tap much fresh territory.

A DECISION AGAINST BROOKLYN TROLLEY FENDERS.

Justice Jacob Neu in the City Hall Civil Court, Brooklyn, has rendered a decision in the suit brought by the city against the Brooklyn City and Newtown Railroad Company for violating the city ordinance respecting the question of fenders on the trolley cars. The decision is against the city. Justice Neu held that the Common Council had the authority to pass an ordinance requiring safeguards to be placed upon the cars in the interest of the public safety. The ordinance in question, however, required that the fenders should be placed not less than three inches from the ground. On this point Justice Neu said: "I am of the opinion that no device is in existence, nor can be made which can be run within three inches of the track. All the evidence on this trial was to the effect that a device attached to the front platform of the car in order to save life or attain the results which said ordinance was passed to accomplish could not be run safely nor with the proper effect at a distance less than six inches from the rail."

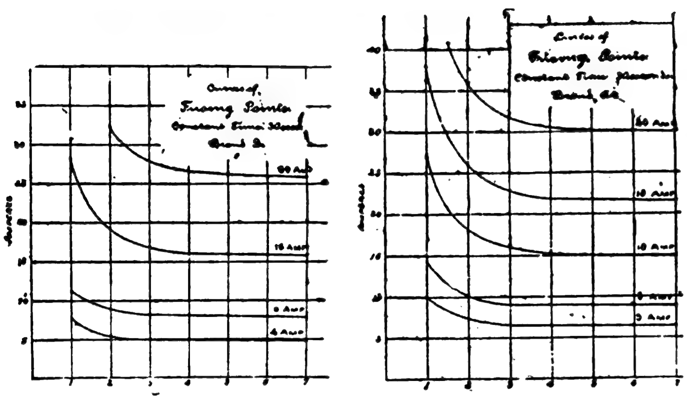
MISCELLANEOUS.

THE RATING AND BEHAVIOR OF FUSE WIRES.—III.

(*Concluded.*)

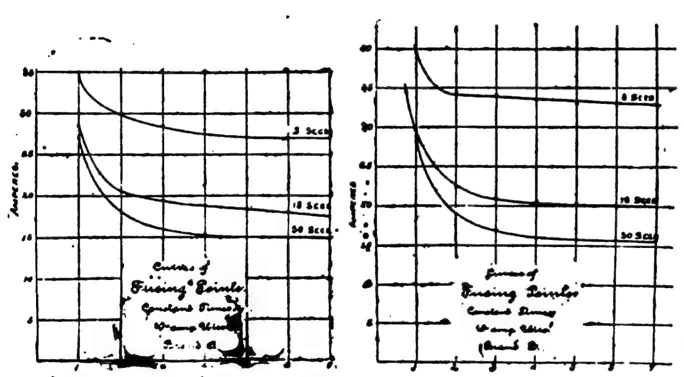
BY W. M. STINE, H. E. GAYTES, AND C. E. FREEMAN.

So much seems to depend on the cooling effect of the terminals that it was determined to work this point out with great care. The terminals of the adjustable block were made of brass, and purposely made unusually massive. Care was also exercised to keep the terminal-contacts bright and clean. Constant fusing times were adopted, with varying lengths. This method of



FIGS. 10 AND 11.

experiment is extremely tedious, since it is not only difficult to ascertain the exact current for a length in a given time, but any slight draught or variation in the current will produce a sensible modification in this time. Up to this point the current has been obtained from a 50-K. W. 110-volt D. C. dynamo, furnishing a sufficiently constant E. M. F. For the following tests a storage battery of 60, 180-ampere hour cells was employed. The result for a constant time of 30 seconds is shown in Figs. 10 and 11; and for constant times of 30, 15 and 5 seconds in Figs. 12 and 13. The relation between size of wire and length of fuse for maxi-



FIGS. 12 AND 13.

mum sensibility is shown by the curves of Figs. 10 and 11. The curves of Fig. 13 exhibit well the sluggish action of the fuse wire. For five seconds two inches is the critical length, while for a time of 30 seconds it is nearly five inches. Data for times longer than 30 seconds are not materially different from those at this period. For a given fuse, then, blown in a given time, there is a critical length. We are now in possession of full data for the complete discussion of this most important question.

If a fuse is to be employed for maximum sensibility at normal rating, the curves at Fig. 11 will enable the length to be determined by the location of the critical point in the curve, which is the point at which the cooling effect of the terminals becomes marked. For three and five-ampere fuses, lengths of 2½ inches should be employed; the 10 and 15-ampere fuses indicate a length of 3½ inches, the 20-ampere of 4 inches. Judged of by common practice these lengths seem excessive, but the data clearly indicate where practice might be corrected.

Comparing the curves in Fig. 2 with these, it is readily seen that the effect of the terminals is equivalent to shortening the time as in Fig. 13, and so increasing the carrying capacity. But these short lengths in no case fuse normally. It is only adding the complexity of the fuse to the uncertainty of the contact. Should the fuse itself become oxidized, the carrying capacity will be largely augmented. We believe sufficient data has been presented to show that it is poor practice to employ short lengths to economize in porcelain.

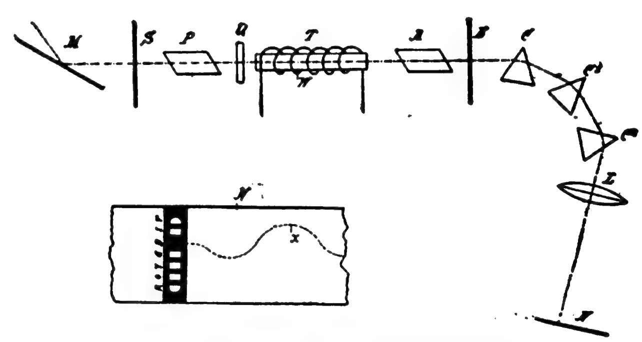
We may now summarize some of the practical conclusions deduced:

1. Covered fuses are more sensitive than open ones.
2. Fuse wire should be rated for its carrying capacity for the ordinary lengths employed.
2. (*a*) When fusing a circuit, the distance between the terminals should be considered.
3. On important circuits, fuses should be frequently renewed.
4. The inertia of a fuse for high currents must be considered when protecting special devices.
5. Fuses should be operated under normal conditions to insure certainty of results.
6. Fuses up to five amperes should be at least 1½ inches long, one-half inch to be added for each increment of five amperes capacity.
7. Round fuse wire should not be employed in excess of 30 amperes capacity. For higher currents flat ribbons exceeding four inches in length should be employed.

Armour Institute of Technology,
Chicago, Oct. 1, 1895.

THE CREHORE PHOTOGRAPHIC CURRENT INDICATOR.

IN apparatus heretofore used for the determination of the character of electric currents trouble has frequently been experienced from the fact that the forced oscillations of a vibrator having weight, however slight, become so superimposed upon those due to the current that the two sets of vibrations become inseparably mixed together and the record obtained fails to show the true condition of the current in consequence. To avoid this



FIGS. 1 AND 2.—CREHORE'S METHOD OF PHOTOGRAPHING ALTERNATING CURRENT CURVES.

difficulty Dr. Albert C. Crehore has introduced a weightless vibrator, consisting of a beam of light, subjected to the influence of the current to be studied in such a way that the character of the current is indicated directly by a line upon a strip of sensitized paper.

Dr. Crehore's method consists in measuring the changes in a current by rotating through the action of the current the planes of polarization of the component rays in a beam of polarized light passed through an analyzer and resolved into the colors of the spectrum, and then photographing the variations of the beam.

The accompanying diagrams, Figs. 1 and 2, represent, respectively, the complete apparatus and a portion of the sensitized strip with the spectrum and photographic record. In the former, M is the mirror of a heliostat from which a beam of light is thrown through an opening in the screen S. In the path of this beam are placed two Nicol prisms, P and A, acting, respectively, as polarizer and analyzer, a tube of carbon bisulphide T used for varying the rotation of the plane of polarization, and a plate of quartz, Q, cut perpendicularly to the optic axis. This last increases the action of the bisulphide of carbon and produces a band which it retains within the visual spectrum, even when the current in the wire W, which constitutes the magnetic field, falls below zero. The beam of light passes through a slit in the screen E and the prisms C, C¹, C², a spectrum being thus produced which is projected through the lens L upon the sensitized strip N.

The planes of polarization of the different components or rays of the beam of light are rotated to different definite extents by the quartz, and the rotation is varied by the action of the magnetic field upon the bisulphide of carbon to an extent exactly

corresponding to the variations in the current which produces the magnetic field.

With no current flowing in the coil W, the analyzer is rotated about its horizontal axis through such an angle as will cause the disappearance from the spectrum of a color produced by a certain component ray of the beam, a dark band appearing in its place. The analyzer is then fixed in place and the current turned on, when a greater or less rotation of the plane of polarization is produced, the colors to the right or left of blue being cut out in accord with the increase or diminution of the current. As one color disappears the one last cut out reappears, thus causing the dark band to travel along the spectrum.

This is recorded upon the sensitized plate N, Fig. 2, and, if the film be moved uniformly, the fluctuation of the current will be shown by the sinuous line x.

For any given current the position of the band is always the same, so that its motion may be calibrated by passing different known currents through the coil. A scale having been thus established, any unknown current is easily measured and its variations or fluctuations may be determined.

EDISON ON THE USELESSNESS OF PATENTS.[1]

BY RUFUS R. WILSON.

"Mr. Edison," said I, "there is a popular impression that you have made a great deal of money from your inventions."

"Considered purely as inventions, they have cost me more than I have ever received from them," was the prompt reply. Then noting the look of surprise on my face, he went on: "At least nine of my inventions have proved very profitable. These are the district telegraph system, the quadruplex system of telegraphy, the stock ticker, the telephone, the electric pen and mimeograph, the incandescent lighting system, the electric railroad, the phonograph and the kinetograph. I claim one-half of the credit for the invention of the first, third and fourth of these and the others are entirely my work. I received very little for the district telegraph. I sold the quadruplex system of telegraphy for $30,000 and spent all of this sum and more trying to devise a plan to make a wire carry six messages instead of four. I failed, and so in the end was worse off than when I began. The stock ticker brought me at different times about $50,000, but it cost me more than that to perfect it. From the telephone I realized a clear profit of perhaps $25,000. Bell made less than half a million, though his father-in-law rolled up a vast fortune by securing control of large blocks of stock when it was selling for little or nothing. The profits of my electric pen and mimeograph have been very small. The incandescent light has netted me $140,000; it cost me nearly three times that sum to perfect it. I did not get my money back from the electric railway, which I sold out long ago, and I made nothing from the phonograph, which I have also sold. The kinetograph has not as yet returned me the original outlay. Our present patent laws, which, as interpreted by the courts, encourage perjury and put a premium on fraud, are worse than a farce, and I would have been a gainer if I had never taken out a patent. However, you must not think from this that I have not made money, but I have made it as a manufacturer and not as an inventor. My different inventions now furnish employment for 100,000 men, and this number is constantly increasing."

"Then you would not advise a young inventor to take out a patent?"

"That would be my advice in most cases," was the reply. "For example, a certain mechanical operation may require the time and labor of forty men, but some clever fellow invents a machine that will do it with the help of only one man. With such a machine the inventor can manufacture the product at one-thirty-ninth of its cost to his rival, and can cut the price in two and still make a profit of at least 95 per cent. on the labor alone. As long as he keeps the machine to himself he will have a monopoly of the market. But if he takes out a patent, in nine cases out of ten his idea will be stolen, and as soon as his rival secures a similar machine his invention will have lost its value. As a matter of fact, many of the most valuable inventions have never been patented, and are kept as a secret process. Stub steel is used all over the world for making certain kinds of fine springs, and yet there are only two or three people now living who know how it is made. Sealskins are dyed at only one place in the world—London. The secret was discovered by a Vermont man, who carried it to England, and the process has been kept there ever since. I could mention many other products in common use whose manufacture is a secret, one workman knowing only one part of the process, and not the whole of it, as a rule. Most of these are made in Europe, like Chartreuse, whose secret is kept by the monks at the Monastery of Chartreuse. In many of our largest factories strangers are denied admission for fear of some secret process leaking out, and the workmen are sworn not to divulge the facts. The Dupont powder works, on the Brandywine, are a striking example of this policy of secrecy as practised in America. The Duponts have rarely if ever taken out patents on any of their processes, but hand them down from father to son, and the workman who enters their employ generally remains with them as long as he lives."

"You spoke somewhat harshly of our patent laws a moment ago," I interjected.

"And with reason," said Mr. Edison with emphasis. "No sooner does an inventor make known some important mechanical discovery by applying for a patent, than a pirate comes along and steals it. Years pass before the case comes to trial, and in the meantime the practice of the courts gives the pirate the benefit of the doubt. Many patents are decided in the inventor's favor only when the patent is about to expire, and has therefore become almost worthless. This is all wrong. The courts should give the man who first secures a patent or first makes application for it the benefit of the doubt until the question of priority has been finally passed upon and settled. As it is now, the pirate staves off the trial from year to year and the poor inventor is robbed of his due, but if the change I mention was made, patent cases would be speedily brought to trial and in most instances justice done to all. When it is made, as it is sure to be sooner or later, there will be a rush of invention and discovery in this country such as we have never seen. Under present conditions, however, not the big but the small inventions, a new toy for children, an improved lamp burner, and the like, are the ones that are making the most money. Their insignificance protects them against the pirate who fails to discover that there is money to be made by stealing them. Still, my advice to a young inventor would be to study the expensive operations of all large factories—every operation, you know, is expensive in proportion to the number of men required—and try to devise a machine with which fewer men could do the work. The wealth of the modern world has been made by labor-saving machinery."

"The end has not yet been reached in this field, and it is still possible for a young inventor to devise a machine for some operation essential to the manufacture of steel which would save the labor of a number of men. Then if he went into the manufacture of that one product on his own account, he could hold his own with all the other manufacturers and undersell them as long as he kept his machine a secret. There is no better method by which the inventor in these days can get the full benefit of his invention."

"What," I asked, "will be the general tendency of invention in the near future?"

"That," said Mr. Edison, "is a question which no one can answer with certainty, but I think for many years to come invention will deal in the main with securing greater economy of motive power. The turning of coal into motive power without the mediation of steam will be one of the next great triumphs of the inventor. I have for some years been at work on the problem of turning coal directly into electricity. I have clearly demonstrated that this can be done, and it now remains to be seen if it can be done at a profit. It would be a great thing if we could run a steamship or a locomotive engine for one-sixth of what it now costs, but I believe it can be done."

LIGHTNING ARRESTERS FOR LIGHT AND POWER CIRCUITS.

In a recent issue the *Elektrotechnische Zeitschrift* discusses the above-named subject. The gist of its remarks are as follows: It is about 50 years since electrical engineers recognized the necessity of protecting electrical circuits by lightning arresters, and during that time the apparatus constructed for this purpose has generally proved quite satisfactory for telegraphic and telephonic circuits. The same, however, cannot be said of the apparatus intended for the protection of light and power circuits and electrical machinery. It may seem strange at first, that a contrivance which is reliable enough to protect the most sensitive receiver of a transatlantic cable cannot be employed for the protection of far more robust objects, such as dynamos or transformers. There is, however, a difference in principle. While in the first instance it is sufficient to keep the discharge from the instruments, in the second the instrument is required, in addition, to prevent the working current from following the path created for it by the lightning discharge. It is especially this latter condition which makes the problem so difficult, and which has resulted in a great number of ingenious contrivances. The practical value of these are regarded differently, and though the *Elektrotechnische Zeitschrift* would not like to say that the various lightning arresters at present in the market are not the best which can be made under existing circumstances, it would like to point out that even these do not afford that degree of safety which could be wished for in the interest of the industry. The main reason for this uncertainty, in which we still remain in regard to the best types of lightning arresters, is that we are still unable to produce artificial lightning which would allow of a systematic testing of apparatus. So far, laboratory experiments give us only an approximate verdict on the value of this or that type, and the real test must be left to nature and chance. In this way, of course, much data may be

1. Abstract from *The Monthly Illustrator*, Nov., 1895.

got together in time, and would allow of the design of lightning arresters on scientific principles. Up to the present, however, this point has not been reached, and an attempt to treat this question systematically and on the basis of experiment would be of great advantage to electrical engineering. Such an attempt could be made through the combined action of the different electrical societies of Germany. The experience gained with the existing type of apparatus should be first collected, and then, together with all other material, put into the hands of a committee for further investigation.

Power Transmission.

EXISTING COMMERCIAL APPLICATIONS OF ELECTRICAL POWER FROM NIAGARA FALLS.[1]—I.

BY W. L. R. EMMET.

The contract made with the Niagara Falls Power Co., by the Pittsburg Reduction Co., requires the continuous delivery of 1500 electrical horse-power in direct current at 160 volts. The aluminum process is a continuous one, and cannot be interrupted without serious loss, since the product is not perfect while the furnaces are being started, or when they are not in their normal working condition. It is, therefore, necessary that spare apparatus be always held in reserve so that in case of accident the proper working conditions cannot be seriously interrupted. To fill these requirements the Cataract Construction Company has ordered from the General Electric Company the apparatus which is now installed in the Reduction Company's building.

This apparatus consists of four rotary converters, having capacity of 400 K. W. each, and eight transformers, each with a capacity of 200 K. W. The rotary converters are intended to be used three at once in parallel, the fourth being always in reserve. These machines transform two-phase currents at 115 volts into direct current at 160 volts, the output of the three being 7,000 amperes which will be delivered continuously.

The stationary transformers are designed for a primary voltage of 1,000 and a secondary voltage of 115, their function being to reduce the current generated in the main power station, to a suitable pressure for conversion into the desired direct current. In addition to the rotary converters and transformers, the General Electric Company has furnished switchboards, conductors, cooling apparatus, cables to connect the plant to the generating station and all necessary accessories.

Rotary Converters.—The rotary converters installed, are of 20

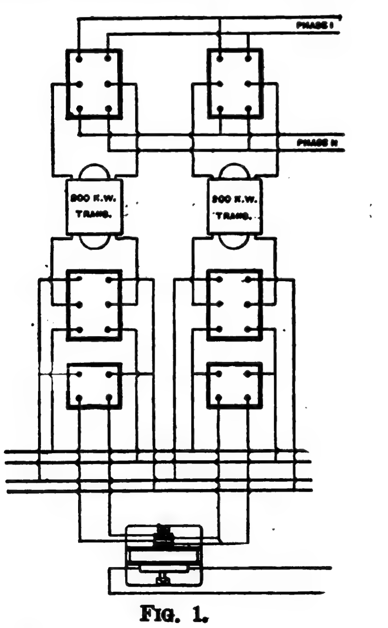


Fig. 1.

poles, and are operated at 150 revolutions per minute, giving a frequency of 25 cycles per second. The armature is of the smooth body type, having a cylindrical winding of conductors formed of pressed stranded cables. These cables are made up of small bare copper wires loosely twisted into a strand. In spite of this pressing together of the wires, we find, by experiments, that parasitic currents are practically eliminated by this form of construction. On each side of the laminations of the armature there are cylindrical extensions for the crossings of the armature conductors. The whole winding is on a cylindrical surface, the ends of the stranded cables themselves being jointed together at the outer edges of the extensions. This machine has a small armature reaction, 5,500 ampere turns per pole, and has an average potential difference between commutator bars of 3.6 volts. Copper gauze brushes are used, there being 20 studs with three brush-holders per stud. The brushes are shifted and raised from the commutator all at once by hand-wheels. The field frame of the machine is cast-iron, and the magnet cores and pole-pieces are of cast-steel. The cores are made in spool form, there being an enlargement at one end to form the pole-pieces and at the other, to

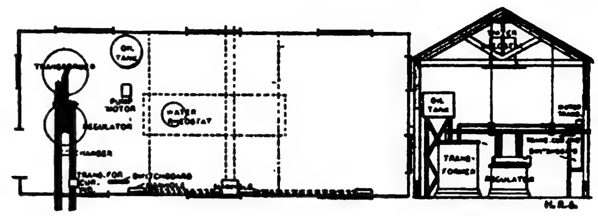


Fig. 2.

increase the area of contact with the cast-iron. The commercial efficiency of these machines is about 94 per cent.

The stationary transformers used in the plant are of 200 K. W. capacity each, eight being used in all. They are kept from injurious heating, by currents of air delivered from below, which passes upward through the body of the transformer, and over the surface of the coils. There are four primary and five secondary coils in the transformer alternately placed with air spaces between them. This arrangement gives ample cooling surface, and freedom from magnetic leakage.

The effect of the air-blast is very great, the maximum temperature being practically reached in three hours. If the air-blast were stopped when operating under normal conditions, about three hours would elapse before a dangerous temperature was reached. The air is supplied by a 60-inch Sturtevant blower, directly coupled to a five-H. P. motor. Two of these are installed, one as a reserve. Either will give sufficient air to cool 3,000 H. P. in transformers.[1]

The room in which this apparatus is placed is 48′ x 87′, and is designed and arranged to receive apparatus to the amount of 4,000 H. P. Only half this capacity is now installed.

With some machines of this class there is no difficulty whatever in starting, while with others it is impossible to start from the alternating current alone. The machines here installed, will start from the alternating current and come up to synchronism promptly. After one machine is in motion, the others will be started from the direct current side, a set of connections and a resistance box being installed for that purpose.

In throwing machines of this character into parallel, great care must be observed. We must be sure that they are exactly in synchronism, and also that the direct current polarity is the same. To accomplish this we have arranged a system of phase lamps, by which both these points are shown. Each machine is fitted with 7 lamps which are required for lighting the room and the machine. Four of these are on the collector side of the machine and are so arranged by switches that they can be connected as phase lamps, two on each side of the two phase system between the machine and the alternating bus bars. When all four lamps burn together and the fluctuations of the light become very low, the machine is ready to throw in. If through misplaced switches or wrong connections the polarity of the machine and alternating circuit do not agree, two of the phase lamps will burn while the others are out.

The General Electric Company has installed four 900,000 C. M. cables which connect this plant with the main generating station. These cables are lead covered and insulated with rubber. They are jointed inside of the Reduction Company's building to small cables which lead to the switchboards near the transformers.

Another of the important contracts closed by the Niagara Falls Power Company for the delivering of electric power from the Falls, is that with the Carborundum Company. The amount of power to be delivered in the present case is to be 1,000 H. P. The pressure required at the beginning of the process is 250 volts, and at the end 100 volts. The current begins at 3,000 and ends at 7,500 amperes. The power is to be taken from one side of the 2,000-volt two-phase system. A number of different methods of supplying this power were proposed and discussed, and the contract for building the apparatus was finally awarded to the General Electric Company, the fitness of the design proposed being, I believe, the principal ground for awarding the contract. (See Fig. 2.) The chief merits of this apparatus are, first, it works without change of connection or opening of the circuit. Second, it is practically non-inductive at all stages of the process, the apparatus being so designed that the magnetizing currents are small, and self-induction is in no way depended upon for the control of the current. Third, the process is continuous, the voltage varying gradually, not in steps. Fourth, the apparatus is controlled automatically.

1. Abstract of a paper read before the Amer. Inst. Elec. Engrs., Niagara Falls, June 28, 1895.

1. For a detailed description and illustrations of the static and rotary transformers, switchboard and air blast arrangements, see The Electrical Engineer, Aug. 15, 1894.

STANDARD ELEVATOR & MFG. CO.'S HIGH DUTY ELECTRIC ELEVATOR.

THE adaptability of electricity to all service where power is required was never so apparent as in its application to passenger elevators. The modern elevator is one of the essential features of civilized society. Not only is it indispensable to all office buildings, but it is now considered a necessity in all hotels, club houses and buildings of any pretension. The many drawbacks of the hydraulic elevator, coupled with the great cost of installation and maintenance, has limited the field of the elevator up to date, but the success of the electric hoist seems destined to develop a market the extent of which has not yet been calculated.

The essential features of the electric elevator are (a) high speed, (b) absolute safety, (c) completely under control of operator, (d) applicable to the current to be supplied by the lighting mains, (e) low cost of operation and maintenance. All of these features are said to be combined in the new elevator recently brought out by the Standard Elevator and Manufacturing Company, of Chicago. The electrical design of this elevator is by Frank B. Rae, the well known electrical engineer.

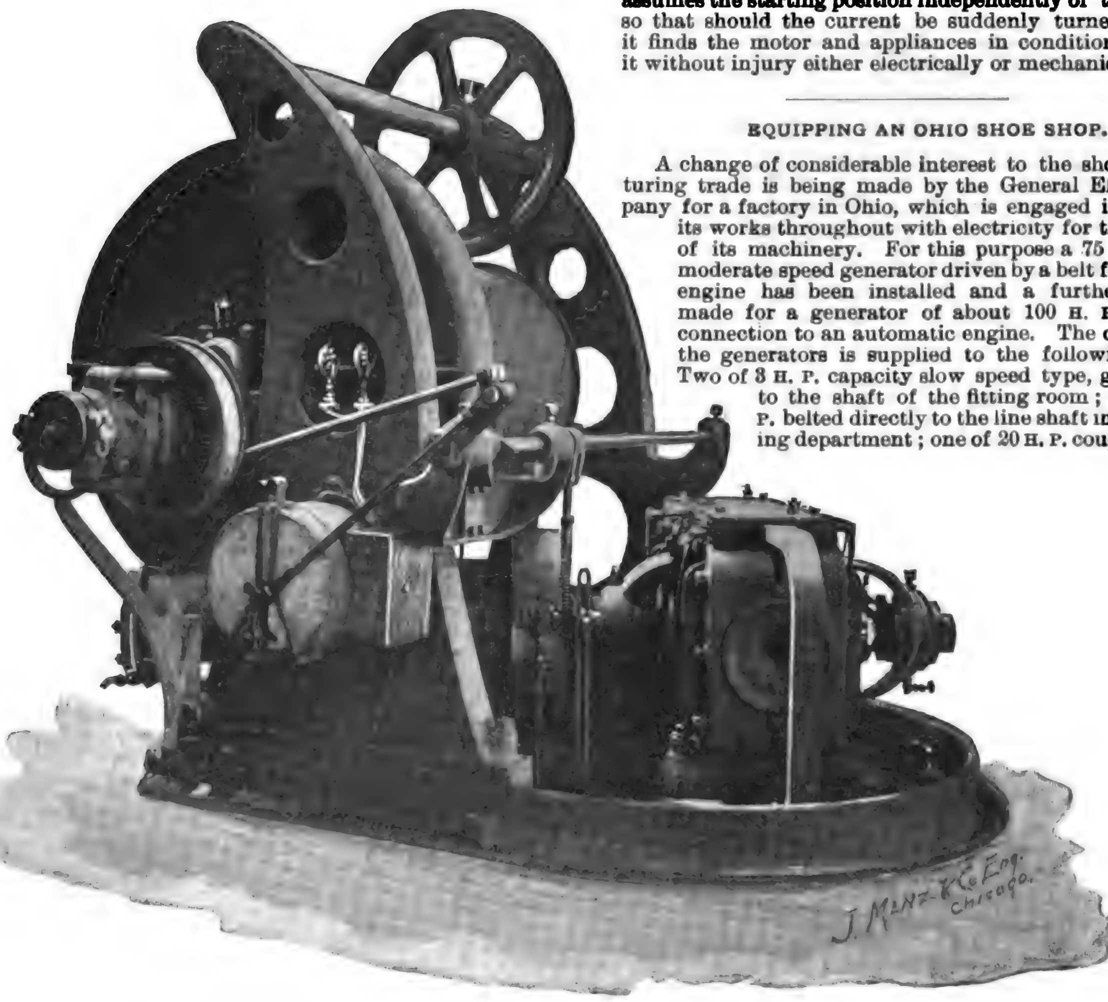
In the introduction of electric elevators the first objection to overcome was that offered by the companies supplying the current. It is well-known that many of the Edison companies refuse to permit more than 25 amperes of current at 220 volts to be drawn from their mains at any one instant, as a greater strain would seriously interfere with the lights. Heretofore this has been obviated by the operator waiting until, by the cutting out of resistances, the 50, 60 or 70 amperes necessary to start the load, is introduced into the motor. This involves considerable delay, in addition to consuming a large amount of energy that is not required. Mr. Rae solved this problem by designing a motor specially adapted for the work, that is, a motor having a field of very large magnetic carrying capacity that can be energized at starting by a very large number of ampere turns. Thus the starting torque is provided by an intensely strong field and a small current.

Heretofore the greater part of the 220 volts provided by the lighting mains to electric elevators has been wasted in external resistances, leaving but little for the motor. In the Standard motor, however, there are no external resistances whatever, but a large number of turns are provided, giving the required ampere turns for energizing the field naturally.

The safety devices are novel and effective. An automatic locking device on the electrical controller and switch prevents injury if the car is loaded beyond its rated capacity. Under this condition of overload it is impossible for the operator to increase the current, the locking device holding the switch at the position of maximum lifting capacity of the motor. This permits a heavy load to be raised at slow speed with absolute safety.

In case of the car meeting with an obstruction when running at high speed, such as a tight place in the guides, the controller device will automatically diminish the speed and increase the power applied, so that when the obstruction is passed, the car will again accelerate independently of, but under the control of, the operator.

Another valuable feature is that in case the current ceases, owing to interruption by stoppage of the generating plant, or break in the supply conductors, the controller at once assumes the starting position independently of the operator, so that should the current be suddenly turned on again, it finds the motor and appliances in condition to receive it without injury either electrically or mechanically.



THE STANDARD ELEVATOR & MFG. CO.'S ELECTRIC ELEVATOR, WITH RAE MOTOR

EQUIPPING AN OHIO SHOE SHOP.

A change of considerable interest to the shoe manufacturing trade is being made by the General Electric Company for a factory in Ohio, which is engaged in equipping its works throughout with electricity for the operation of its machinery. For this purpose a 75 H. P. M. P. moderate speed generator driven by a belt from a steam engine has been installed and a further provision made for a generator of about 100 H. P. for direct connection to an automatic engine. The current from the generators is supplied to the following motors: Two of 3 H. P. capacity slow speed type, geared direct to the shaft of the fitting room; one of 15 H. P. belted directly to the line shaft in the bottoming department; one of 20 H. P. coupled directly to the dust collector. A further installation of motors will be made a little later on in the fitting room and also in the bottoming department. Still another motor will run an additional dust collector, and two belted motors will run elevators. The first motors were started a few days ago and the operation of the machinery so far seems perfect. This is the first step towards the adoption of electricity in shoe manufactories in that section.

DETROIT ELECTRICAL WORKS.

A movement is on foot to reorganize the defunct Detroit Electrical Works, says the *Detroit Tribune*, and put the plant upon a firm footing. The scheme is in the hands of James I. Ayer, of St. Louis, Cameron Currie and Thomas Jerome, of this city. It is proposed, if possible, to buy the works at the price which they would bring at a forced sale, which would be, it is estimated, about $50,000. The idea which has been advanced is to raise $50,000 to buy the works, and then to raise about $100,000 to be used as operating capital. The works are said to be worth about $200,000 as an electrical plant.

PERSONAL.

HERMAN BERGHOLTZ.

Herman Bergholtz.

THE portrait given herewith is not only that of a well known young electrical engineer and "promoter,"—if we may use that word in a eulogistic sense,—but of a man of most agreeable personality. Mr. Herman Bergholtz is not an American by birth, but he might just as well have been. He is about 32 years old and left Sweden some twelve years ago in the hope that the new world would afford some scope for his tastes and energies. He has been actively engaged in the electrical field almost from the moment of his landing, first in incandescent lighting, then in arc, in manufacturing and finally in the construction and operation of electric roads. At the present time he has to some extent concentrated his forces at Ithaca, N. Y., where, as manager of the electric railway and lighting properties, he has greatly changed, improved and developed things. He has also interested himself in the Renwick tract, one of the most beautiful of the new suburbs of the university city that is growing up around Cornell. It is said that not less than half a million dollars has thus been invested under his direction and advice in and around Ithaca. He is also president of the Cortland & Homer Traction Co. Mr. Bergholtz has the honor of being a brother-in-law of Prof. Elihu Thomson, having married a sister some few years ago.

DR. DURAND WOODMAN has been elected to the office of secretary and treasurer of the American Chemical Society, New York Section.

PRES. A. B. CHANDLER, of the Postal Telegraph Co., accompanied by his son Mr. Albert Chandler and by vice president George G. Ward, of the Commercial Cable Co. has been making a long Southern trip of inspection, with a view to further developments of the excellent system he has built up.

MR. H. M. SLOAN, who for the last two years and a half has been superintendent of the Superior (Wis.) railway system, has been made general manager of the Calumet Electric Street Railway, Chicago. The vacancy was caused by the promotion of the former general manager, John Farson, to the presidency of the road.

MARRIED.

GILLETTE—CAMP.

The marriage is announced of Mr. Joseph Gillette, superintendent of the Naugatuck Electric Company, to Miss Grace H. Camp of New Britain, Conn., by the Rev. Dr. Cooper, the ceremony being performed at the bride's residence.

A PRACTICAL COURSE AT OAKLAND, CAL.

Mr. Arthur C. Robbins, the electrical engineer of the Electric Specialties Co., of Oakland, Cal., has begun a good course of lessons in practical electrical engineering, the terms being $5 for the couse of 20 lectures. The class has started with 40 students drawn from all circles, but chiefly from the electric and cable railroads. The lectures are given each Saturday night and are aided by practical apparatus.

LEGAL NOTES.

AN OUTLINE OF RECENT LITIGATION ON SOCKETS.

In view of the present interest in the question of sockets, and the fact that the General Electric Co. has been pushing some suits under the Bergmann patents, a brief review of the situation will be of interest and value.

Briefly stated, the suits on the Bergmann patent covering sockets, cut-outs, etc., provided with contacts attached to receive lamp bases or plugs having the Edison style of terminals, are as follows: The first suit was brought in October, 1891, by the Edison Electric Light Company against the Electric Engineering & Supply Company, the well known concern of Syracuse, in the United States Circuit Court for the Northern District of New York. It was brought on for final hearing before Judge Alfred C. Coxe, at Utica, and a decree was entered on April 10, 1894, establishing the validity of the Bergmann patent No. 257,277, the Edison Company's title, and the fact of infringement by the defendant. A perpetual injunction was granted, and the accounting by the defendant for profits and damages is now in progress.

An appeal was taken from the decision of Judge Coxe to the United States Circuit Court of Appeals, and resulted in the decision being affirmed so far as said Bergmann patent was concerned.

Prior to the determination of the suit against the Electric Engineering & Supply Co., suit had been brought against the Bryant Electric Co., of Bridgeport, Conn., in the United States Circuit Court for the District of Connecticut. After the decision sustaining the Bergmann patent, motion was made for preliminary injunction, and was granted, and a preliminary injunction issued. Later, in view of the affirmance by the Circuit Court of Appeals of the decision of Judge Coxe, the Bryant Company voluntarily submitted to a final decree, which was duly entered and perpetual injunction issued and served.

In the past six weeks, a number of suits have been brought against various concerns engaged in the manufacture of electrical appliances, these concerns having, it is alleged, manufactured and sold sockets and cut-outs in infringement of the Bergmann patent. Among these are the firm of Pass & Seymour, manufacturers of electrical specialties at Syracuse, who are now under injunction granted by Judge Coxe on October 15, 1895, and the Perkins Electric Switch Mfg. Co., of Hartford, Conn., who are under injunction granted by Judge Townsend on October 22nd. In addition to these, suits are now pending on behalf of the Edison Electric Light Company against the Anchor Electric Co. and the Boston Switch Mfg. Co., two Maine corporations doing business chiefly in Boston, Mass. A motion for preliminary injunction has been made in each case, and was heard on the 14th instant at Portland, Maine, by Judge Webb. Suits have also been commenced against the Metropolitan Electric Company and the Electrical Appliance Company. A motion has been made for preliminary injunction in each case, and will be heard by Judge Showalter at Chicago on November 20th.

APPEAL IN THE BRUSH DOUBLE CARBON LAMP SUIT.

The United States Circuit Court of Appeals at Chicago heard arguments on the appeal of the Brush Electric Company from the decision of Judge Showalter, which held that the Western Electric Company did not infringe on the patent on the double carbon arc lamp.

NEWARK TROLLEY FREIGHT.

The City Counsel of Newark, N. J., has decided that trolley companies have no right to carry freight on express cars specially designed for that purpose. General Manager Young of the Consolidated Traction Company expressed himself as being very much surprised at the decision of City Counsel Riker. Mr. Young said that he supposed that all State laws took precedence over laws enacted by cities, and that the right of the company to operate freight cars was established, according to his way of thinking, by a State law enacted in 1893. He also said that under the decision of the City Counsel the company had no right to allow a passenger to carry a bundle on the car, for the bundle was freight under the decision.

THE ELMIRA & HORSEHEADS case, involving an injunction under the Thomson-Houston trolley patents, came up last week in the New York Circuit Court of Appeals, before Judges Wallace, Shipman and Lacombe.

THE ENGLISH CARRY SLIDE RULES.

Mr. W. L. Spence, of Wolverhampton, Eng., writes: "The Data Sheets promise to be very useful if compound multiplication tables—852 Sheet 1—are excluded. In this country we carry slide rules."

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED NOV. 12, 1895.

Accumulators :—

Storage Battery, M. Moskowitz, Newark, N. J., 549,649. Filed April 20, 1895.
The active material is held in hollow pans placed horizontally.

Alarms and Signals :—

Automatic Danger Signal Apparatus, F. Henius, Newark, N. J., 549,789. Filed April 23, 1895.
A system of signaling cars passing in oppos'te directions on parallel tracks, especially when the tracks are close together.

Conductors, Conduits and Insulators :—

Device for Pulling Ropes Through Conduits, P. C. Volland, Baltimore, Md., 549,757. Filed July 15, 1895.

Composition of Ma'ter for Compressed or Molded Articles, R. N. Pratt, Hartford, Conn., and H. W. Johns, New York, 549,855. Filed June 2, 1887.
A composition for an electric insulating material consisting of asbestos, rubber and soapstone or other insulating equivalents.

Dynamos and Motors :—

Dynamo-Brush, J. Dickson and R. G. Shapcott, London, Eng., 549,502. Filed July 7, 1893.
Copper wires are plaited and compressed into a flat band which is enclosed in a jacket of wire gauze.

Electric Elevator, H. R. Smith, Chicago, Ill., 549,542. Filed Mch. 4, 1895.
Details of construction.

Regulation for Alternating Generators, E. P. Ide, Eau Claire, Wis., 549,644. Filed Apr. 6, 1895.
Regulation is effected by variation of the fields of the exciting generator.

Carbon Brush Holder, G. H. White, Chicago, Ill., 549,663. Filed Aug. 5, 1895.

Electric Motor, R. Lundell, Brooklyn, N. Y., 549,876. Filed Mch. 2, 1893.
The energising coil or coils carried wholly by the rotary part, while the field magnet or stationary part is not provided with any windings or energising coils whatever, the rotary part being provided also with commutator or current-collecting brushes connected directly with the current-mains and adapted to short-circuit those coils of the armature which are passing out of the field as the armature rotates.

Lamps and Appurtenances :—

Lamp Shade, W. R. Hitchcock, Cornwall, Can., 549,723. Filed Mch. 27, 1895.

Bracket for Incandescent Electric Lights, W. R. Hitchcock, Cornwall, Can., 549,724. Filed Mch. 27, 1895.
A flexible bracket arm.

Carbon Clamp, K. A. Lantau, Chicago, Ill., 549,731. Filed April 30, 1895.
Of the ball and socket type with V-shaped clamps.

Arc Lamp Globe Holder, G. L. Moyer, Hartford, Conn., 549,577. Filed Mch. 19, 1895.

Measurement :—

Electric Meter, R. O. Hood, Danvers, Mass., 549,886. Filed June 8, 1895.
The invention consists of a movable structure acted on dynamically by a coil placed in the circuit to be measured, devices for automatically and intermittingly reversing the movement of the structure, and means for recording the operations.

Miscellaneous :—

Can-Capping Machine, J. M. Colbert, Mantua, N. J., 549,629. Filed June 10, 1895.
Feeding devices for alternately moving the cans forward and raising and lowering them, and intermediate control devices controlled by the lifting of the cans for throwing the acid feeding and soldering devices into action when the cans are lifted.

Electrical Steering Gear, G. S. Grimston & A. H. Dykes, London, Eng., 549,636. Filed Apl. 9, 1895.
Details of a steering-gear operated by an electric motor.

Apparatus for Heating and Lighting, H. T. Yaryan, Toledo, Ohio, 549,664. Filed Aug. 6, 1894.
An apparatus for the utilization of the excess of heat generated by an electric plant during the period of its maximum load.

Electric-Clock System, A. Franke, Berlin, Germany, 549,715. Filed Sept. 19, 1893.
Has reference to a system for synchronizing a series of clocks from a primary or master clock.

Electric Speed Regulator, C. W. Larson, Schenectady, N. Y., 549,874. Filed Apl. 8, 1895.
The combination with an engine, of a counterbalanced governor therefor mounted in universally moving bearing upon a fixed support, yielding power connections between the engine and the governor, and means actuated by the governor for controlling the speed or power of the engine.

Railways and Appliances :—

Electric Locomotive, F. B. Badt, Chicago, Ill., 549,485. Filed Aug. 1, 1895.
Claim: In an electrically propelled vehicle, the combination with a starting motor or motors, of a speed motor or motors, an operating lever for controlling the circuit through the starting motor or motors, and operating lever for controlling the circuit through the speed motor or motors, and a lock for preventing the movement of the operating lever of the speed motor or motors beyond a predetermined point until after the operating lever of the starting motor or motors has been moved to disconnect the starting motor or motors.

Electric Motor System and Traction Device, T. P. Milligan, So. Orange, N. J., 549,523. Filed Jan. 26, 1895.
The invention consists in a track supported on posts and an electric motor held to the rail by its own rolling-gear and driving-wheels, and a system of levers whereby the traction or grip of the driving-wheels on the rail is automatically adjusted to the resistance of the canal-boat or other object to be moved.

Conduit Electric Railway System, B. E. Osborn, Auburn, N. Y., 549,580. Filed July 14, 1894.
Details of construction.

Controller for Electric Motors, M. J. Wightman and O. Urban, Scranton, Pa., 549,621. Filed Feb. 6, 1895.
Relates to electric motors operated and controlled on the "series-multiple" system, and is designed to overcome inequalities in the distribution of the load between the two motors.

Friction Appliance for Electric Cars, I. W. Heysinger, Philadelphia, Pa., 549,642. Filed May 18, 1895.
Composed substantially of a substance which is a good conductor of electricity, the contiguous particles thereof adapted to maintain the passage of the electric current from wheels to track rail without increase of resistance or retardation and at the same time produce friction between wheels and trackway.

Underground Electric Propulsion, J. E. Parker, New York, 549,652. Filed June 23, 1894.
Details of construction.

Contact Device for Electric Railways, C. A. Phillipsborn, Berlin, Germany, 549,655. Filed Apl. 20, 1893.
A double trolley intended for 2 and 3-phase work.

Switches, Cut-Outs, etc.:—

Electric Shunting Device, A. B. Depuy, Camden, N. J., 549,501. Filed Mch 19, 1895.
The combination of a galvanoscope, having fixed to the axis of the needle a cam situated between two flat contact springs; the springs being connected, respectively, one with the coil of the galvanoscope, and the other with the ground.

Automatic Electric Cut-Off, C. E. Whitney, New York, 549,556. Filed Jan. 2, 1895.
An electrically controlled cut-off and time mechanism intended more especially to automatically stop the flow or supply of illuminating gas at any predetermined time.

Combined Rheostat and Reversing Switch for Electric Motors, J. P. B. Fiske, Alliance, Ohio, 549,597. Filed Nov. 6, 1894.
Details of construction

Electric Controller, J. P. B. Fiske, Alliance, Ohio, 549,598. Filed Feb. 18, 1895.
A combined rheostat and reversing-switch.

Electric Controller, W. H. Morgan, Alliance, Ohio, 549,608. Filed Aug. 22, 1895.
Details relating to a motor starting switch.

Lightning and Heavy Current Arrester and Alarm, M. R. Hutchison, Mobile, Ala., 549,794. Filed May 25, 1895.
Consists in the peculiar construction and arrangement of the apparatus and circuits.

Electric Switch, W. T. M. Mottram, Dallas, Texas, 549,810. Filed July 9, 1889.
Claim:—In combination wi h juxtaposed pairs of contact points of an electric system, an electric switch, and a contact plate pivoted to the latter and having its contact faces on each side of the switch whereby said faces are made to adapt themselves to the position of the pairs of contact points to which they are applied.

Telegraphs :—

Multiple Telegraphy, T. B. Dixon, Henderson, Ky., 549,709. Filed Sept. 12, 1895.
Improvement upon the system of multiplex telegraphy described in patent issued to same inventor Aug. 6, 1895, No. 543,984.

Telephones :—

Railway Telephone System, W. H. Clewley, Providence, R. I., 549,491. Filed April 10, 1895.
A system permitting communication from any station of a railway block system with the terminal station. Employs three wires.

Telephone Transmitter, I. Lucas, Passaic, N. J., 549,802. Filed May 15, 1895.
Similar to patent below.

Telephone Transmitter, I. Lucas, Passaic, N. J., 549,803. Filed May 31, 1895.
For description see page 496 this issue.

Telephone, A. Stromberg and A. Carlson, Chicago, Ill., 549,860. Filed Sept. 21, 1893.
Has for its object the provision of means whereby the diaphragm may be delicately adjusted, and such adjustment made perfectly secure.

SOCIETY AND CLUB NOTES.

NEW ORLEANS ELECTRICAL SOCIETY.

At their last meeting the Society had a very interesting discussion of the question whether a college education should precede the practical work in any engineering profession. Mr. Perrilliat supported the affirmative and Secretary Malochee took the negative, believing that some practice might well intervene after the high school course, and then a man might go to college if he wished. Prof. Brown Ayres said that at college now, a man got theory and practice together.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The 101st meeting of the Institute, will be held at 12 West 31st Street, on Wednesday, November 20th, at 8 o'clock P. M. The meeting will be devoted to a topical discussion on storage battery applications. Several members having had experience in this field have expressed their intention of giving their views and communications on the subject have already been filed by Messrs. Arthur E. Childs and C. L. Edgar of Boston, Dr. F. B. Crocker and Mr. Nelson W. Perry of New York City, and Mr. Carl Hering of Philadelphia. A similar meeting of Western members will be held the same evening, Wednesday, Nov. 20th, at 8 P. M. in the rooms of the Western Society of Engineers, 1737 Monadnock Building, Chicago. Non-members are cordially invited to attend the meeting, either in New York or Chicago. As we go to press, we learn that a meeting has also been organized for the same evening, on the same topic, at San Francisco.

REPORTS OF COMPANIES.

MANHATTAN RAILWAY EARNINGS.

The Manhattan Railway report for the year ending Sept. 30, published last week shows as follows:—

	1895.	1894.	Changes.
Gross earnings	$9,745,926	$10,138,143	Dec.... $392,217
Op. expenses	6,132,827	6,095,557	Inc.... 37,270
Net earnings	$3,613,099	$4,042,586	Dec.... $429,487
Int. and rentals	2,204,887	2,002,406	Inc.... 202,481
Balance	$1,408,212	$2,040,180	Dec.... $631,968
Dividends	1,800,000	1,800,000	
Deficit	$391,788	*$240,180	

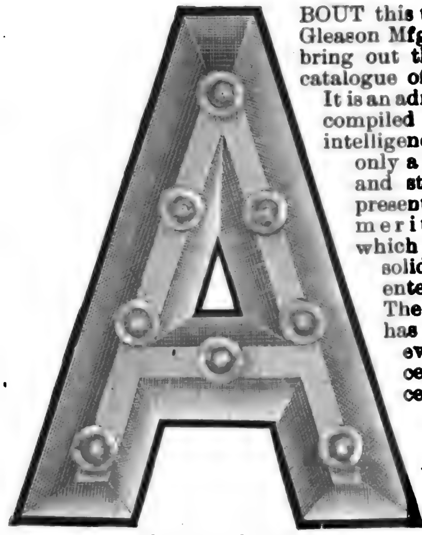
*Surplus

The number of passengers carried was: Manhattan lines, 179,234,356, against 190,669,854 in 1894; Suburban branch, 8,838,-289, against 5,489,460; total, 188,072,645, against 196,159,323 in 1894, a decrease of 8,086,678 passengers.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE NEW GLEASON CATALOGUE.



Gleason Alphabetical Lamp Sign.

ABOUT this time each year, the E. P. Gleason Mfg. Co., 181-9 Mercer street, bring out the latest edition of their catalogue of electric light supplies. It is an admirable production, being compiled with much care and intelligence and embracing not only a large variety of standard and staple goods, but always presenting a number of the meritorious novelties with which the firm uphold and solidify their reputation for enterprise and ingenuity. The edition for 1895-6, which has just reached us, is in every way a worthy successor to the long list of preceding issues. It is a handsome large quarto in green cover and reaches no fewer than 210 pages. It contains at least 700 cuts, many of which are new and beautiful, and all of which not only embellish the text but enable the user of such goods to order exactly the style and quality that he is in need of. It would be impossible for us here to enumerate the different kinds of articles included in this book, but we may safely generalize by saying that all the fixtures that a a central station company or private plant may require in the line of brass, iron or glass are to be found within its teeming pages. There are also many details and articles that do not come within the "fixture" category, but are always in demand, such as soldering salts, material for coloring incandescent bulbs, testing magnetos, alcohol torches and blow pipes, binding posts, etc.

One ingenious line of goods is exemplified in the initial letter of this notice. There is a great demand to-day for electric light signs, and they may be seen wherever one goes. At the same time, it is not easy to construct these letters and signs, and hence E. P. Gleason & Co. have brought out what we may term an electric light alphabet. It consists of letters made entirely of metal, as the cut shows. The back is removable, so that the wiring can be got at without trouble. The face is enameled white and is concave, so that the illuminating effect of the lamps is intensified. The letter A in our initial is made with only eight lamps, but is 30 inches high, and can be seen an enormous distance. Obviously much fewer lamps are needed than in ordinary electric letters, and the effect is greatly superior in brilliancy. It seems to us that when electric light managers have mastered this easy alphabet, they should be able to do a lot of tall spelling all over the cities they live in.

We note also among the miscellaneous specialties a line of excellent portable stands for telephone desk transmitters, in polished brass, on slate base, and of pretty and convenient patterns. It will be remembered that this house is a large producer not only of gas, oil and electric light fixtures, but of glass ware, and the exhibition made of it in this catalogue is at once profuse and most creditable. There are so many rich and handsome designs, one wonders what the firm will treat the public to next.

PURCHASE OF THE WADDELL-ENTZ PROPERTY BY THE TRIUMPH ELECTRIC CO.

Mr. J. C. Hobart, manager of the Triumph Electric Co., of Cincinnati, issues under date of Nov. 18, the following important notice :—

We wish to announce to our friends and patrons through your columns that we have bought the entire plant, including all patents, formerly belonging to the Waddell-Entz Co., of Bridgeport, Conn. We are now moving this plant to this city where it will be added to our present equipment, giving us one of the best equipped plants in this line in the West.

The former Waddell-Entz machines are well and favorably known and universally acknowledged as essentially high grade machines. The same excellence of detail and design will be adhered to, embodying such improvements as experience has suggested. Our own reputation for high grade work is a guarantee in itself that nothing else will leave our hands, and we trust that those of your readers who have desired information concerning this machine in the past, and been unable to get it, will note that it is again on the market, and that any correspondence addressed to us on the subject will have prompt and careful attention.

It is by no means our intention to discontinue any of our present Triumph patterns, the many popular features of which have been so well demonstrated. It will be our aim in the future as in the past to give prompt and careful attention to work entrusted to us.

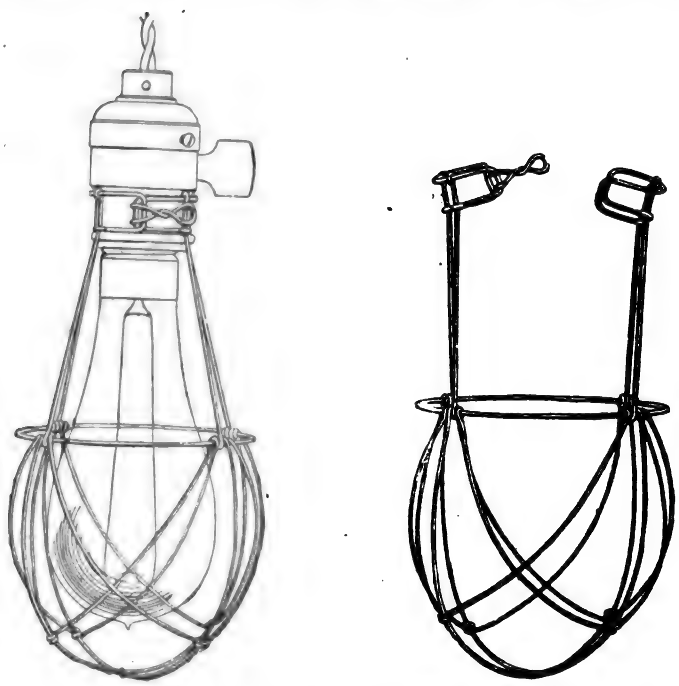
THE MATHER FACTORY FOR SALE.

Our readers will be interested to know that the extensive factory occupied for years by the Mather Electric Co., at Manchester, Ct., is at last for sale, and full particulars can be procured from Charles M. Jarvis, Receiver, East Berlin, Ct. This factory was more than doubled in capacity two or three years ago, and has all the modern appliances for doing first class work, being well equipped with new and labor saving machinery. The Mather Co. have had a precarious career, and now the complete plant is offered at a bargain. It is a good opportunity for any engineering concern, either commencing business, or desirous of increasing their present capacity.

THE "PERFECTION" INCANDESCENT LAMP GUARD.

THE life of an incandescent lamp is not alone influenced by internal deterioration going on constantly during the hours of burning, but many lamps are so situated as to be subject to mechanical injury and breakage. To protect them from external harm therefore a guard of some kind is often required. An excellent device of this nature is the "Perfection" lamp guard manufactured by Mr. William Inglis, of Detroit, Mich.

The accompanying engravings, Figs. 1 and 2, show, respectively, the guard attached to the socket, and detached. One of the principal merits of the guard lies in its fastening. The latter is made to fit the socket very snugly, and the hasp or lock being put through the opposite loop and lapped over, as shown in Fig. 1, draws all the wires around the socket in the tightest possible manner and holds the guard upon the socket rigidly, thus protecting the lamp when put to the most severe usages. The fastening being made in the nature of a hinge, the guard can be easily taken off and replaced without bending the wires out of shape, which is so apt to occur with the guards made with slides.



FIGS. 1 AND 2.—"PERFECTION" INCANDESCENT LAMP GUARD.

The "Perfection" guard, which is made to fit all styles of sockets, is of bright tinned wire, silver finish, and is exceedingly neat in appearance.

The "Light Guard" also manufactured by Mr. Inglis consists of a wire ring surrounding the bulb and rigidly held by two wire supports connected to the socket. It throws no shadows and is easily applied to the socket. It is not only a protection against breakage of the lamp but is an excellent device for holding shades as well.

NATIONAL CARBON CO.

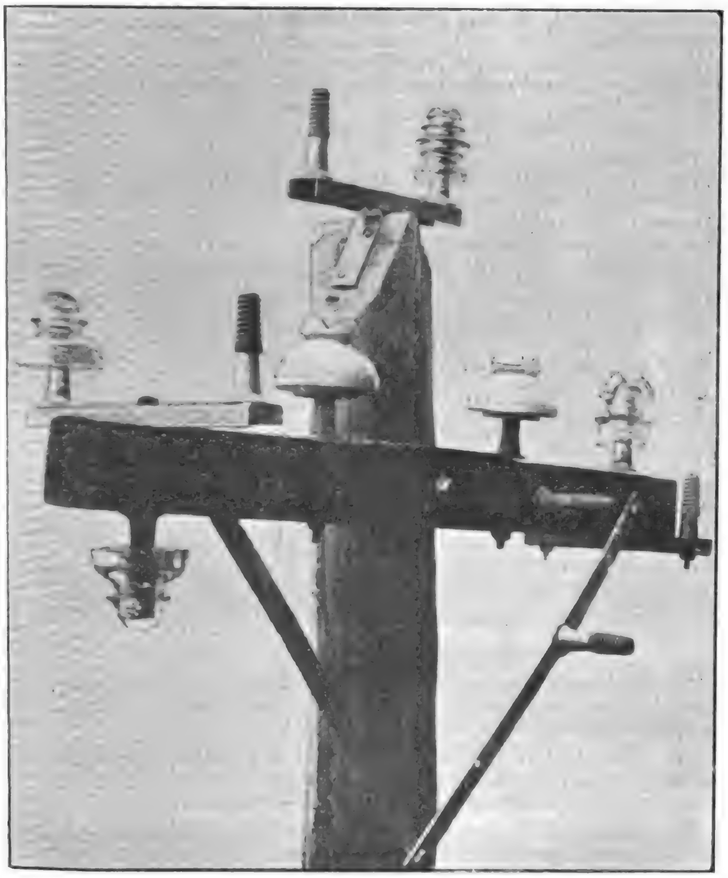
With regard to the reports of a recent fire in their factory at Cleveland, the National Carbon Co. write us that the fire was not as serious as was made out by the newspapers, and that they are again running with full regularity.

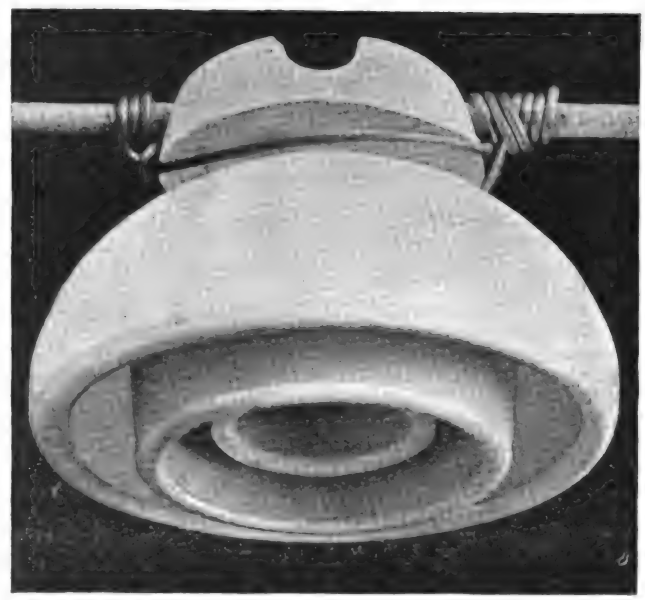
Mr. Henry Grieh, chairman of the Fire Committee of Butler, Pa., informs us that the City Councils have decided to install a fire alarm system and that he will be glad to be addressed on the subject.

THE LOCKE INDESTRUCTIBLE STEEL INSULATING PIN AND INSULATORS.

In these days of ever increasing potentials in power transmission work high line insulation is a sine qua non. But the older applications such as the telegraph and telephone have so long been suffering from the baneful effects of bad insulation that the tendency towards better line insulation is making itself felt to a marked degree, as evidenced by the use of improved line material of all kinds. Concentrating his efforts on this branch of work Mr. Frederick M. Locke, of Victor, N. Y., has brought out a variety of line material some of which we illustrate in the accompanying engravings.

Next to the insulator itself, the pin on which it is mounted claims attention from the line constructor. For this purpose Mr. Locke has designed a steel insulating pin. This pin is constructed with a steel bolt passing from the top of the pin through a half inch hole in the cross arm, and is securely fastened on the underside by a nut and washer. The iron cap between the top of the insulator pin and the cross arm serves as a brace to resist the strain of the pull on the pin, and at the same time covers the pin hole in the cross arm, thereby keeping out water and moisture and preserving the arm.





FIGS. 1 AND 2.—LOCKE INDESTRUCTIBLE STEEL INSULATING PIN AND INSULATORS.

The pin evidently is unbreakable and does not rot like a wooden pin. Another great advantage lies in the fact that it does not weaken the cross-arm nearly so much as the ordinary wooden pin, the difference in the diameter of the pin hole being that between ½ inch and 1¼ inch.

The indestructible steel pins have been extensively used as corner pins, and on long distance transmission lines where very high potentials are used. They are convenient to replace broken wooden pins, or when extra pins are needed between wooden pins already in use.

As shown in the engraving, Fig. 1, they can be used bottom side up on the underside of a cross arm when it is desired to add wires to a line without increasing the number of cross arms. For iron pole fittings a ⅜ inch by 5 inch pin is made, which can readily be attached, and when in place is neither cumbersome, expensive nor inconvenient as is the case when ordinary blacksmith fixtures are used.

In Fig. 1 there are shown a few of the many uses to which the indestructible steel insulator pin may be put. As will be observed the pins can be attached to the top, bottom and sides of the cross arm, or to pole tops, break arms, or to cross arm braces. Wherever placed, they present a neat appearance and may be depended upon to resist all reasonable strains of line construction. The illustration also shows the Locke patent break arm in position under and on top of the cross arm, also the Locke large triple petticoat porcelain insulator, triple petticoat glass insulator, transposition insulator and cable insulator.

The triple petticoat china insulator, shown in Fig. 2, is made from the highest grade chinaware. It measures 5¼ inches in diameter and 4 inches in height, and has over 12 inches of surface between the wire contact and the supporting pin. About 10 inches of this surface is on the under side of the insulator, out of reach of direct rainfall, where it keeps comparatively dry. The surfaces of the bottom of the insulator are perpendicular, and therefore catch no foreign matter. By repeated practical tests it has been found that a potential of 85,000 volts is required to puncture the insulator; hence it will carry with safety and economy any voltage that is practicable for use in the commercial application of electric power.

The body and glaze of these insulators are of simple earths only, fused together into a vitreous, homogeneous mass at the greatest heat. No lead or other metallic oxide being used in making, the glaze is not a conductor. The body and glaze being of exactly the same material and fired at the same heat, the insulating qualities are as high without as with the glaze.

NEW BRUSH ELECTRIC LIGHTING PLANT AT GALENA, ILL.

The opening of the electric light plant at Galena, Ill., recently by its owner, Mr. W. L. Primm, formerly of Chicago, was witnessed by many of the prominent citizens of the city, among whom were the Mayor, J. G. Schmohle; the Electric Light Commissioners, consisting of Messrs. W. A Bancroft, Wm. Kirchbaum, and Wm. Gibson, who are also Aldermen of Galena, and Mr. John Heid. We understand there was considerable opposition to having the city lighted by electricity, but when the lights were turned on satisfaction was expressed on all sides with the result, even by those who were most bitterly opposed to the scheme originally. The contrast between the appearance of the city when lighted by gas and when lighted by electric lights was startling in the extreme, and Mr. Primm received many congratulations on the effect. The Brush system is used and supplies 104 lights of which 20 are arc, and the remainder 40-candle incandescents. The citizens of Galena are congratulated on having such an active and progressive Mayor and Board of Aldermen, who believing the city would be benefitted by the new mode of lighting, pushed the matter to a head in spite of the opposition. The handsome Brush dynamo is run by a Corliss engine.

MR. W. A. SHELT writes us with regard to the report that he has secured a 20-year franchise at Covington, Ky., and says that he is located at Covington, O, and is installing there a new 900-light Westinghouse alternator, 2,000 volts primary. He is proprietor and electrician of the Beard Electric Light Co.

ADVERTISERS' HINTS.

MICA, INDIA OR AMBER, is supplied for all purposes of insulation by Eugene Munsell & Co., of this city.

ARC LAMPS FOR ALL CIRCUITS are offered by Mr. R. B. Corey; in fact, anything in the line of arc lamps or imported carbons.

THE STANDARD AIR-BRAKE CO. say that if their apparatus were not winning its way they would not care to spend money in advertising it.

THE ELECTRIC APPLIANCE CO. give another of their very practical examples for Station Managers. These examples "prove' and are wonderfully convincing.

AN INSULATING PIN that will last as long as the pole and even longer, is being extensively sold by Mr. F. M. Locke, of Victor, N. Y. This is only one of his specialties.

HART & HEGEMAN are glad to respond to all inquiries regarding their flush switches. They have recently brought out some new designs in these goods.

MICANITE commutator rings, segments, slot troughs, cloth and paper are advertised by the Mica Insulator Co., who say that manufacturers of electrical machinery have adopted Micanite as the standard of insulation.

WESTINGHOUSE ENGINES are all tested before they leave the shop and a record card, guaranteed correct, goes with them. If you are interested in engines, the Westinghouse Machine Co. will send you a descriptive pamphlet, on receipt of your card.

"PUTTY" is the title of the Central Electric Co.'s "ad" in this issue and they tell where it may, and may not be found. The latter they say applies to Okonite Wires and Interior Conduits as nothing but the best material and workmanship are employed in their manufacture.

NEW YORK NOTES.

THE MCBAIR ELECTRIC HEATING CO. has been incorporated at Middletown, N. J., with a capital stock of $2,000. The directors are H. C. McBair, T. E. Hayes, and H. M. Hayes.

THE DICKINSON ELECTRIC SUPPLY CO. has been formed in this city by H. S. Ritter, H. H. Dickinson and A. S. Goodacre, with a capital stock of $10,000.

MR. J. C. FORSYTH has been temporarily appointed chief inspector of the Electrical Division of the New York Board of Fire Underwriters. The former chief has been transferred to another division.

NEW YORK CITY.—The Metropolitan Traction Co. has secured control of the Eighth Avenue line, and it is said there is a likelihood that the road may be turned into an underground trolley system, like the Lenox Avenue.

ONONDAGA DYNAMO CO.—The Endrick Woolen Mills at Great Barrington, Mass., have been wired for electric lights. The mill will be equipped with an electric plant from the Onondaga Dynamo Company, Syracuse, N. Y., which will have a capacity of 600 lights.

THE RUETE CONDUIT CO., of 26 Cortlandt Street, Room 702, are putting on the market a new insulated iron conduit, single tube system, the invention of Messrs. E. T. Greenfield and W. T. Ruete, both well-known conduit men. Mr. Frederick Noll is manager of the sales department. The factory is in Jersey City.

NEW YORK BRUSH STATION.—Owing to the explosion of a main steam pipe, the Brush station on Elizabeth street was shut down for one or two nights last week. The steam pipe was quickly repaired, but the escaped steam did serious damage to the belts and apparatus, which caused delay in starting up again. Several hundred lights were temporarily affected.

MR. FRANK S. DE RONDE, general sales agent for the Standard Paint Co., reports that the concern is selling more P. & B. than ever. The P. & B. insulating tape and motor cloth are meeting with a specially large sale among the street railways of this country and England. The company has just opened a London office at 39 Victoria Street, S. W., and will keep on hand there a full stock of all its products.

WESTERN NOTES.

THE HAYES-TRACY-FYFE CO. has been formed at Chicago, with a capital stock of $30,000, by J. Hayes, E. C. Tracy and H. A. Schyver, to manufacture electrical devices.

THE FORT WAYNE ELECTRIC COMPANY have secured new Chicago offices on the sixth floor of the Marquette building. It will be a handsome business home for Maj. C. A. Munson, who is the Chicago manager for the company.

PARANITE.—As an indication of the fact that Paranite wire is rapidly growing in popular favor, the Electric Appliance Company state that although the factory is running full force night and day they are having great difficulty in keeping even with their orders. They are turning out more rubber covered wire now than at any previous time in the history of their business.

THE WESTERN TELEPHONE CONSTRUCTION CO., of Chicago, have just furnished a 300 telephone exchange equipment to the McKeesport, Pa., Telephone Co., which has been put in place of the apparatus formerly in use there. The McKeesport Exchange is one of the oldest opposition exchanges in the United States, and after trying various kinds of telephone apparatus it has displaced its former central office equipment entirely and adopted the Western.

CLEVELAND, O.—Through the mistake of a conductor, a trolley car at Cleveland plunged through an open draw over the Cuyahoga River, at the Central Viaduct; and no fewer than 15 persons were drowned including the conductor himself, while four persons are still missing. The car had to stop at a derailing switch, but the conductor then gave the signal to go ahead.

MR. H. WHITFORD JONES, manager of the Electric Supply and Mfg. Co., of Cleveland, announces that it has brought out the interest and good will of Mr. C. H. Estinghausen, and that the concern is continuing a brisk business under the most auspicious circumstances. It has recently closed a number of excellent contracts. The Company does all kinds of electrical work, with electric lighting as a specialty.

THE ST. LOUIS, MO., IRON & MACHINE WORKS, have issued a neat little pamphlet dealing with their Corliss engine, giving sizes, views, indicator cards, etc., as well as some illustrations of their factory. The patterns for this engine range from 125 H. P. up to 2,000 H. P. These engines are running generators at Jacksonville, Fla.; Pekin, Ill.; Decatur, Ill.; St. Louis, Mo.; Los Angeles, Cal.; Mound City, Mo; Bloomington, Ill., and other places.

THE RACINE BOAT MFG. CO., of Racine, Wis., have just closed a contract for a large steel steam pleasure yacht to be built here this winter, and will need considerable material and new tools for this work. The boat will be fitted with electric light plant, quadruple expansion engines and tubular boilers, all of which will be built at Racine. The boat will cost $75,000, and will weigh 150 tons.

NEW ENGLAND NOTES.

THE ROBINSON ELECTRIC TRUCK AND SUPPLY CO. have issued a pretty and interesting souvenir of the Montreal Convention, which includes a view of the city river front and a number of illustrations of their truck in actual service.

THE BERLIN IRON BRIDGE CO., of East Berlin, Conn., have just completed for Jas. McLaren, of Brooklyn, N. Y., a new iron building to cover his stone yard. The yard is 70 feet in width and 120 feet in length, and the building covers the entire yard and is arranged to carry a traveling crane of 15 tons capacity, so that stone can be moved to any part of the yard by power, making it one of the most complete stone cutting yards in this vicinity.

PHILADELPHIA NOTES.

THE ELECTRIC STORAGE BATTERY CO., may, it is reported, establish a plant at Niagara, utilizing the cheap power, and turn, ing out about 250 tons of battery per day.

MR. L. W. BYERS, for four years past the efficient superintendent of the Pottstown, Pa. Light, Heat & Power Co., is to enter the service of Walker & Kepler in Philadelphia.

MR. GEORGE A. MILLER has been appointed superintendent of the Pottstown Light, Heat & Power Co., being promoted to this position from that of assistant superintendent.

FRANK H. STEWART & CO., 35 North Seventh St., are making a special drive on Knife Switches, which they are turning out in large quantities. They publish prices in another column which tells the story of their success.

THE WILBRAHAM-BAKER BLOWER CO., of Philadelphia, Pa. have placed the order for their new pattern store house with The Berlin Iron Bridge Co., of East Berlin, Conn. The building will be 64 ft. wide and 86 ft. long, one story high, with brick side walls covered with the Berlin patent anti-condensation corrugated iron roof covering, and will be absolutely fire-proof.

SOUTHERN NOTES.

ATHENS ELECTRIC EQUIPMENT CO. This concern has been started at Athens, Ga., by Messrs. O. A. Dozier, manager, and T. H. Dozier, secretary and treasurer, both of whom are young men of energy and ability. They are prepared to contract for any work in the electric line.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

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ELECTRIC TRANSPORTATION DEPARTMENT.

THE NEW STORAGE BATTERY CARS ON THE MADISON AVENUE LINE, NEW YORK.

I.—INTRODUCTORY.

THE first attempt worthy of the name, to operate a street railway by storage battery cars in the United States was carried out in 1889 by the New York and Harlem Railway Co., in New York, on Fourth and Madison Avenues. Many of our readers will remember that these cars, ten in number, were equipped with Julien cells and that they were operated for several months, sandwiched in among the horse cars of the line. The reasons which induced the the company to abandon the further use of battery cars need not be here gone into, but suffice it to say that the question of cost of operation was not the principal one, and hence the Company has always looked with favor on the system and has ever since expressed its willingness to give fair trial to any system of this nature showing promise of success and quite free from the annoyance of patent litigation.

The time that has elapsed since the first attempt has served to bring about vast improvements in the storage battery, and, besides, the experience gained in storage traction work abroad served as a valuable guide to present American work in this field.

With these points in view, the Electric Storage Battery Co. a short time since entered into negotiations with the New York and Harlem Railway Co., for the equipping of a number of cars, with a view to a thorough determination of the feasibility of storage traction for its lines. These negotiations have resulted in the equipment of the cars described below.

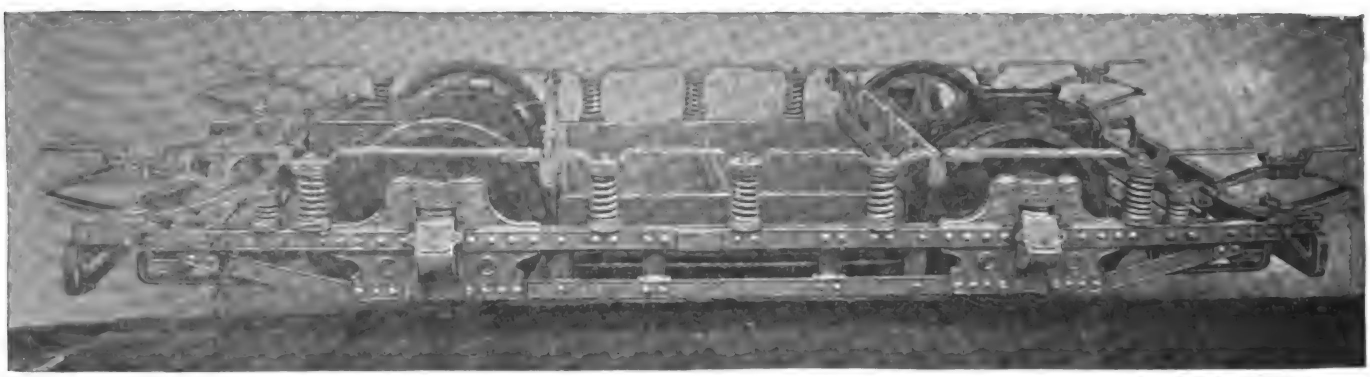


Fig. 1.—Peckham Truck, Storage Battery Car, Madison Ave. Line, New York.

II.—THE LOCATION OF THE BATTERIES ON THE CAR.

Starting out with the source of current, the storage battery, as a reliable piece of apparatus, and having constantly before them the troubles due to a mechanical nature with which previous attempts in this direction had been hampered, the Electric Storage Battery Company have been enabled to bring together a system which pre-

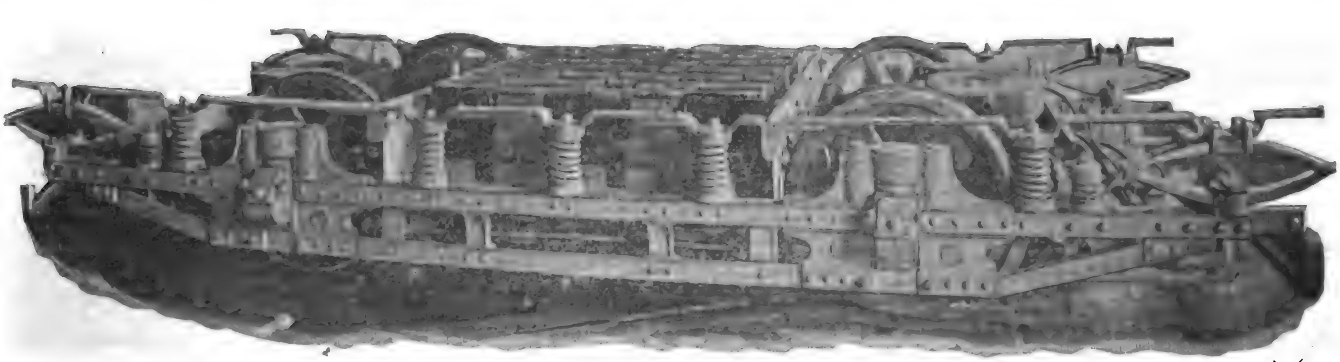
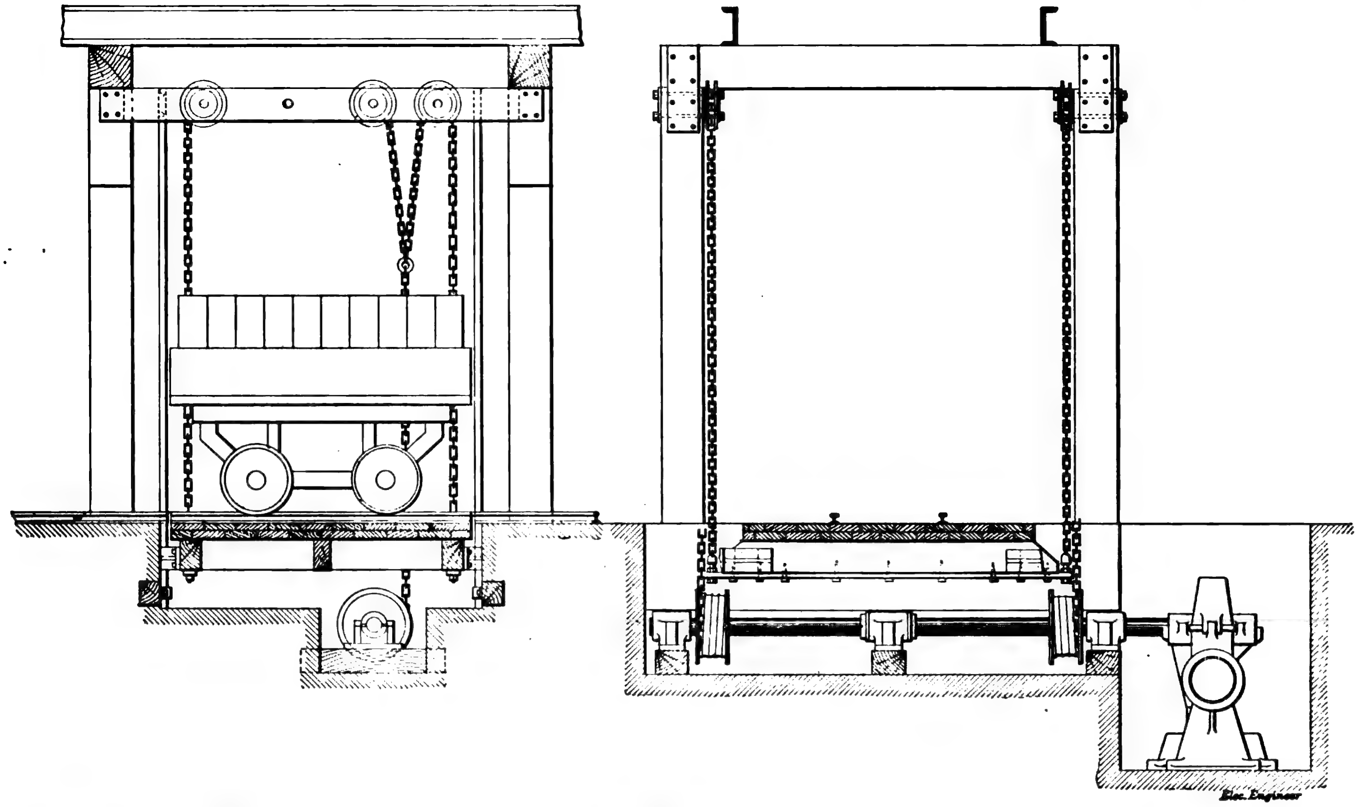


Fig. 2.—Truck of Storage Battery Car with Batteries in Position.



Figs. 3 and 4.—Elevator for Lifting Storage Batteries to Car Truck, Madison Ave. Line, New York.—Side and End Elevation.

sents not only decidedly novel features, but in some respects radical departures from previous practice. First and foremost among these perhaps may be mentioned the method of handling the batteries, and the manner in which they are carried on the car. In all previous work of this class the batteries have in one way or another been carried within, or suspended from, the car body. Thus in the older forms the batteries were disposed under the seats for the passengers, and either let into the sides or through the platform ends of the cars. This in the first place required a heavy construction of the car body to withstand the strain of the additional weight imposed upon them. In the second

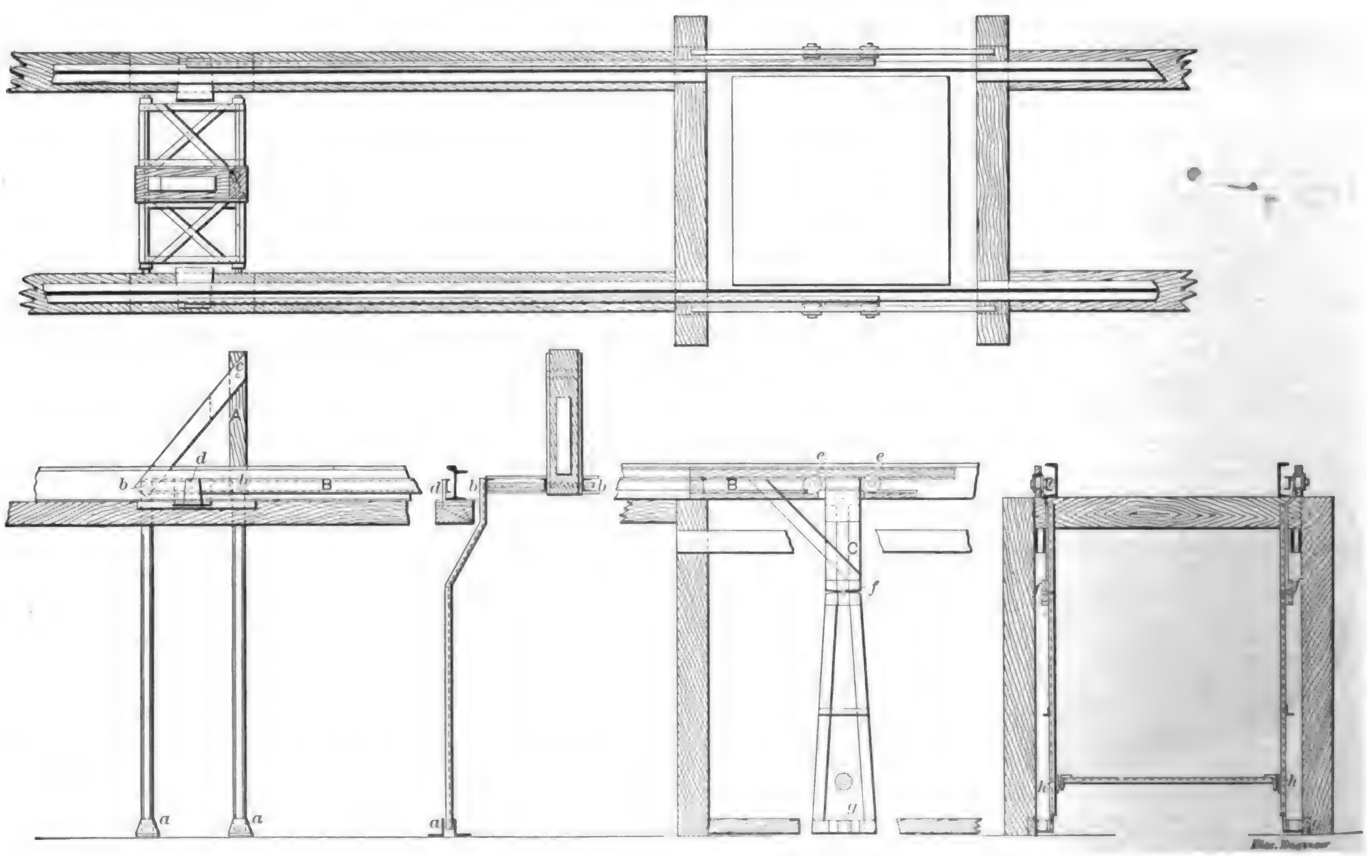


Fig. 5.—Arrangement for Centering Storage Batteries under Car Truck.—Plan Side Elevation and Section.

place, this method required the seats to be wider than would otherwise have been necessary, and invariably resulted in an uncomfortable seat for the passengers, besides taking several inches from the width of the aisle running through the car. To this is to be added the fact that even with the greatest care exercised to prevent it, the acid fumes were usually noticeable in the cars.

It has been sought to overcome part of these troubles by the methods of battery suspension adopted in the storage cars now in operation in Paris. There the batteries are contained in trays suspended from the car bodies between the two bogie trucks upon which the car rests. This, it is true, removes the batteries to the outside of the car body, but does not relieve the car body itself of the strain

done below the level of the street, or of the ground floor of the car house. The batteries are assembled in trays mounted on four wheel trucks; after being charged, they are wheeled to a line of rails extending the complete length of the car house, and by means of turntables transferred to the track running parallel with the track above, upon which the cars are standing. The track upon which the cars enter the car house forms the top of a continuous pit. The small truck carrying the batteries is wheeled directly on to an elevator platform, which, when lifted, brings the batteries directly under the centre of the car at its proper place, and automatically suspends it on to the truck. The elevator with the small battery truck descends free of its load, ready for the next charged battery.

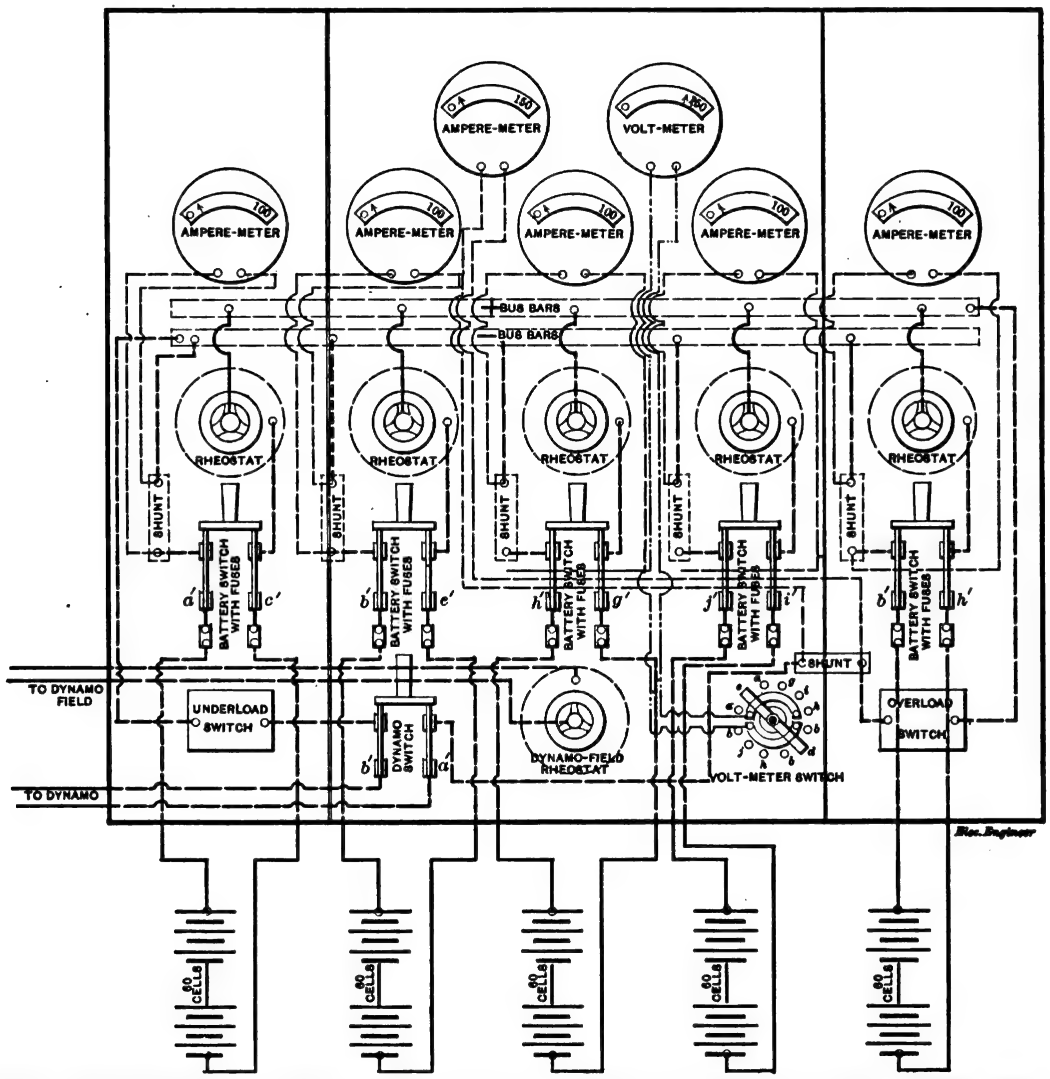


FIG. 6.—DIAGRAM OF SWITCHBOARD CONNECTIONS FOR CHARGING STORAGE BATTERIES, MADISON AVENUE LINE, NEW YORK.

brought upon it by the weight of the battery, while it also subjects the passengers to the more pronounced shocks due to the increased mass of the car body loaded with batteries.

In the method adopted on the new Madison avenue cars all these objections have been at once brushed aside by suspending the battery on the car truck. This relieves the car of all strain, so that it can be built as light as any horse car, and does away with all the other objections, and, as will be seen later, it permits of a facility in the operation and handling of the batteries rendered impossible by the methods employed heretofore.

III.—THE HANDLING OF THE BATTERIES.

In general terms the system of handling the batteries on the Madison avenue line has been so arranged that all work which involves any movement of the batteries whatever is

It will be noted that with the exception of the wheeling of the small trucks carrying the batteries, from their location while charging, no manual labor whatever is required in their handling, and even this part of the work it is intended shortly to free from manual work by a system of hauling cables, which will shift the battery trucks from one position to another automatically. The desire to press forward the equipment as fast as possible has prevented carrying out this detail for the present. This in brief will give a general idea of the methods employed. The details by which these methods have been worked out exhibit considerable ingenuity.

IV.—THE BATTERIES.

Each car is provided with 60 cells, grouped in two series of 30 cells each. The nine-plate traction type of

FIG. 7.—NEW STORAGE BATTERY CAR ON MADISON AVE. LINE, NEW YORK.

Chloride cells is employed, having a capacity of 400 ampere hours, and capable of sustaining a current discharge of 40 amperes for 10 hours. The cells weigh 95 pounds each, making a total weight of 5,700 pounds. It is proposed, however, to put in service shortly a lighter type of battery, weighing only 2400 pounds, which will, of course, necessitate more frequent change of battery. The connections of all the cells are burned together solid throughout, no screws or bolts of any kind being employed. The flexible cables are also burned on at all points, and are brought out to large brass plates on the sides of the trays, shown in Fig. 9, which form the terminals to which double shoes on the car make contact when the battery is lifted into place on the truck. The cells rest in a tray supported by four channel irons which are bent up at the sides of the tray and form ears from which the tray is suspended on the car truck. The outside measurement of the battery cells is 18 inches high, by $5\frac{3}{16}$ x $8\frac{1}{2}$ inches.

In order to prevent splashing, hard rubber grids are placed on the top of the cells, which break up any waves that may be formed by the vibration of the car.

V.—BATTERY SHIFTING DEVICES.

As stated above, the trays containing the batteries rest on four wheel trucks, built by the C. W. Hunt Co., running on 21-inch gauge tracks, which run at right angles to the main track running along the bottom of the pit, over which the street car runs on entering the car house. Our illustration, Fig. 9, shows the battery on the transfer truck. Arriving on the main battery track the transfer truck is shifted on to the elevator, as shown in Fig. 3, and then by the turn of a handle is raised to the level of the track overhead.

The elevator employed in the Madison Avenue stables for this purpose is of the worm and worm-wheel type, and specially designed for this purpose, and built by the Sprague Electric Elevator Company. It can be worked from either side and the arrangement is such that it only requires to be started, stopping automatically at the proper point to land the batteries in the car truck over head. Our illustrations, Figs. 3 and 4, give the details of the elevator arrangements. It may be remarked also that by means of the elevator an armature can be readily removed from the motor.

The tray is provided with beveled cast iron corner pieces, so that even if it should be out of centre $\frac{3}{4}$ of an inch when lifted on to the truck it will automatically slide into its proper place.

VI.—THE CAR TRUCK.

The truck upon which the batteries are mounted is of the Peckham type and of a special design, made by the Peckham Motor Truck & Wheel Co. The Peckham standard truck is employed, but in addition thereto elliptical springs are placed at the ends on which the car body rests, together with extra spiral springs in the centre. Our illustrations, Figs. 1 and 2, show the truck without the batteries, and with the batteries in place. As will be seen the battery tray is hung from two cross-bars, the suspension bar being pushed forward under the ears of the tray, and firmly held in place by a locking arrangement. The truck has a 7 ft. 6 in. wheel base with 30 inch wheels.

VII.—THE BATTERY CENTERING ARRANGEMENT.

In employing an elevator in the handling, it became necessary, of course, to provide means for automatically bringing the batteries in the centre of the car truck when raised. This has been provided for in an ingenious centering arrangement, the details of which are illustrated in the engravings, Fig. 5. The car when arriving above the pit strikes against a bumper A, which is supported by the upright bars or links, pivotted at *a a*, so that the bumper is always in a vertical position. Rigidly connected to this movable bumper is the bar B, with its downwardly projecting guide C. The latter is pivotted at *f* to a pair of rocking guides, which are much further apart at bottom *g* than at top. A small wheel on the transfer truck engages with these guides and thus the truck is gradually moved into proper position as the elevator rises. The result is that should the car have come to a stop not directly above the centre of the elevator, the batteries will nevertheless be guided to the centre of the car by these guide bars. This arrangement, it will be readily seen, economizes greatly in time and obviates the necessity of any exceptional vigilance or skill on the part of the motorman in bringing his car to a stop.

VIII.—THE MOTORS.

The motors with which the truck is provided are of the General Electric "800" type, wound for a maximum of 24 miles an hour, and hence revolving at a greater speed than is usually employed on cars of this type. This winding was selected in order to effect as high an average efficiency of motor as possible with the varying potential employed.

In practice it is not proposed to run above a speed of 12 miles an hour. It will be noticed that, contrary to usual practice, the motors are turned toward the outside of the axles. This arrangement became necessary in order to allow of sufficient room for the insertion of the battery trays.

IX.—THE CAR CONTROLLER.

The K. S. B. controller of the General Electric Co. is employed, giving six combinations, which are shown diagrammatically in Fig. 8. These are: 1. Batteries in parallel, motors in series. 2. Same, with field shunt. 3. Batteries in series, motors in series. 4. Same, with field shunt. 5. Batteries in series, motors in parallel. 6. Same, with shunt.

When the trays are lifted into position on the truck, the terminal plates at their sides are brought up against double contacts at each terminal plate, so as to insure the absolute continuity of circuit. These double contact shoes are pressed forward by steel springs, which, however, do not carry any current.

X.—THE CAR BODIES.

The car bodies employed are of the 18-foot Stephenson type, and are the widest built by this Company. The wood work is no heavier than that of the ordinary horse car, and the whole car has an air of lightness about it in strong contrast to the previous types of storage battery car bodies. It is lighted by two 3-light clusters, one connected to each set of batteries, so that light will always be available.

XI.—THE GENERATING PLANT.

At the present time the current for charging the batteries is obtained from a 13½ K. W. General Electric generator, driven by an Otto gas engine, but there will shortly be erected in addition to this a 30 K. W. Eddy generator, belted direct to a 36 H. P. Otto gas engine.

The charging switchboard, illustrated in Fig. 6, is

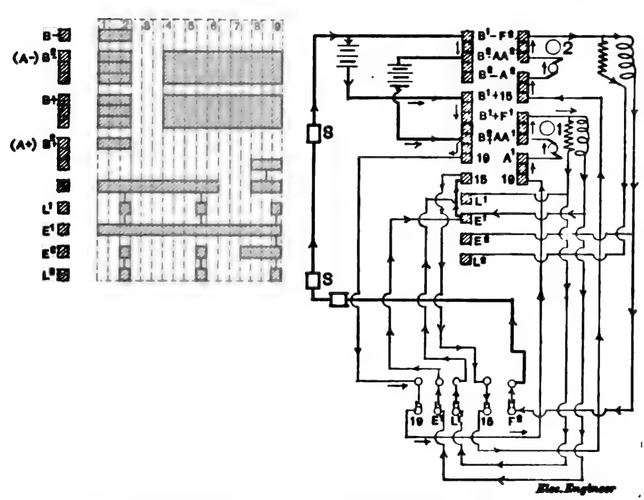


FIG. 8.—DIAGRAM OF CAR CONTROLLER CONNECTIONS.

arranged for five circuits. At the top are placed the main ammeter and the voltmeter and below these the ammeters for the individual charging circuits, followed by handles for operating the resistance in each charging circuit, for obtaining uniformity of charge. At the bottom are placed the main dynamo switch and the rheostat for regulating the field of the generator and the overload and underload switches.

At the present time two cars are in operation on the Madison Avenue line, and these will be subjected to a series of tests which will determine the future course of the Railway Company, looking to the adoption of the storage battery system for its lines. The engineering work and equipment of the cars has been entrusted in the hands of Mr. G. Herbert Condict, and the care with which these have been carried out gives every ground for hope that the

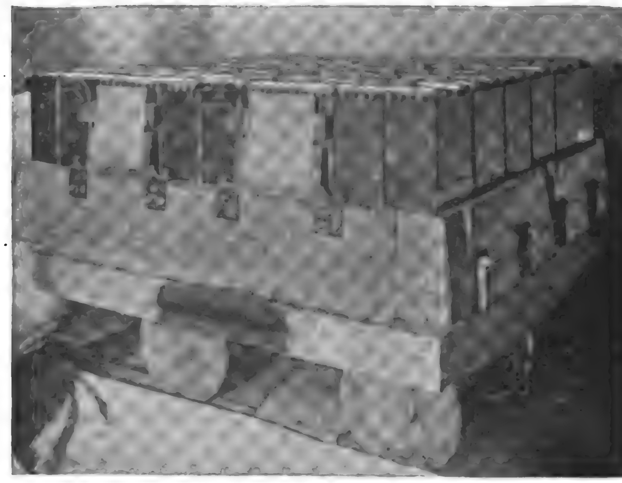


FIG. 9.—BATTERY ON TRANSFER TRUCK.

experiment, if it can be called such, will bring about the much desired introduction of storage batteries in street railway work in this country.

THE MURPHY-PIERCE SUB-TROLLEY SYSTEM.

THE new electrical railway system, invented by John M. Murphy and Albert F. Pierce, of Danbury, Conn., dispenses with the overhead wires and the conduit underneath the car. The surface only of the road is used, and the car takes the power from the section of rail directly beneath it. Between the rails on which the car runs is a third rail, laid in short sections, each section being perfectly insulated from every other section. The car, in passing, automatically engages the section of this third rail directly beneath it, and from it takes its power. This is done by one wheel of the car which touches a push-pin, thus operating mechanism placed underneath the rail, which in turn makes the connection with and charges the section of rail over which the car is passing. As the car moves forward and touches another pin, the section in the rear is cut out the same instant the one forward is charged. The main or feed wire, insulated, is buried along the outside of the track. From this feed wire, insulated wires run to each section of the rail from which the car derives its power. These wires pass to the section through the mechanism, by which the connection is both made and broken. The mechanism is simple, consisting of a lever, a pawl, a wheel, a shaft, and an electrical switch. All of this mechanism is encased in a box cast especially for it, water-tight as well as dust-proof.

There is a fuse box between the wire and every section of rail, which makes it impossible to charge the rail up to the danger point. Any more than the required voltage burns the fuse and makes the rail dead. The charged rail is never exposed from underneath the car. All the mechanism used is cast in the foundry, making it comparatively inexpensive, and also possible to replace any part at a moment's notice. The electrical connection is made and broken by mechanical means. There is no magnetic switch device. An experimental section has been laid at Westport, Conn.

FROM NEW JERSEY TO NEW YORK BY STATEN ISLAND TROLLEY.

It was stated at Elizabeth, N. J., last week, that a deal had been consummated by which the Consolidated Traction Company, which operates about all the trolley lines in Hudson, Essex and Union Counties, had secured control of the dock at the foot of Fulton Street. For some time there have been negotiations for the purchase of this dock. It is said the trolley system of Elizabeth will centre there, and that a ferry will be operated from the dock to a point on the Staten Island shore directly opposite the street.

There are in process of construction on Staten Island two systems of trolley roads, which, while they parallel each other in many instances, are not rivals, for the sections of country which

they open up are different. There are some twenty-five miles of road under construction or nearly completed, and as much more is planned to be built within two years.

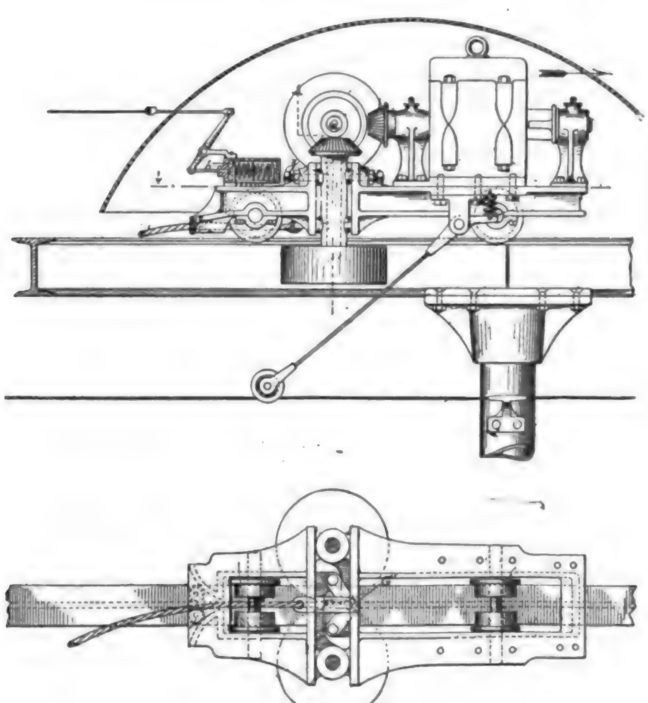
One of the termini of the largest system is at Erastina, opposite the city, but a considerable distance from the point at which the ferry from Elizabeth is expected to land. The village is separated from the shore by salt meadows. For several weeks a big gang of men has been at work on Staten Island building a plank road across the swamp. It is now approaching completion. The branch of the Staten Island road which is to run to Erastina is completed as far as the western end of West New-Brighton, three miles from Erastina. Cars could be run on three days' notice over the completed part. The remainder will not require long to build, and will probably be finished before the Consolidated Company secures the necessary franchises to run its lines to the foot of Fulton Street.

The establishment of the ferry and a reciprocal arrangement between the two traction companies, which have been very friendly since the Staten Island Electric Company was started, would open for the residents of the city a new, short, cheap and pleasant route to New York by way of Staten Island and the ferry to the foot of Whitehall Street.

THE MILLIGAN ELECTRIC CANAL BOAT TRACTION METHOD.

THE determination by popular vote of the State of New York to spend $9,000,000 on the improvement of its canals, taken in conjunction with the recent successful application of electricity to canal boat propulsion by motors from the banks, leaves little room for doubt that within a comparatively short space of time the mule will be banished from the canals of the state if not of the entire Union. Indeed, contracts have already been given out for the electrical equipment of the Erie Canal from Tonawanda to Buffalo, a distance of 14 miles.

It is not surprising, therefore, that inventors are at work



FIGS. 1 AND 2.—MILLIGAN ELECTRIC CANAL BOAT TRACTION METHOD.

devising means for the application of electricity to canal boat traction purposes, and among the latest methods put forward is that of Mr. Thomas P. Milligan, of South Orange, N. J. This system provides for a track supported on posts, and an electric motor held to the rail by its own rolling gear and driving wheels, and a system of levers whereby the grip of the driving wheels on the rail is automatically adjusted to the resistance of the canal boat.

Our illustrations, Figs. 1, 2 and 3, show the arrangement in side, plan and end view, respectively. The rails, which are mounted on posts on the banks of the canal, are wrought iron I-beams. The motor is mounted on wheels resting on top of the I-beam, and through a set of reducing gears drives a pair of wheels which grip the vertical web of the I-beam and thus furnish the tractive force.

In operation, when desiring to start his boat, the boatman pulls a cord, which operates a multiple contact spring piston switch shown at the left in Fig. 1, which sends current into the motor; the amount of pull determining the amount of current and speed of the motor. As soon as the strain comes on the hauling cable

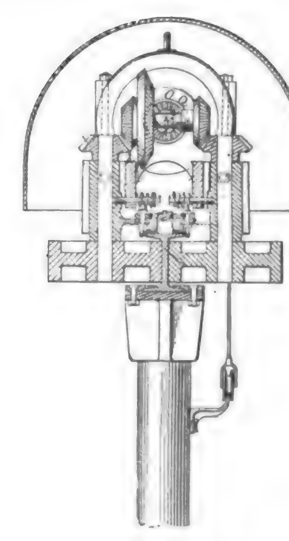


FIG. 3.

a set of toggle levers press the gripping wheels against the web of the I-beam, thus increasing the initial traction produced by springs. When the proper speed has been attained, the switch rope is fastened. When it is desired to stop, the rope is slacked and the piston spring returns the switch to the "off" current position. A device is also employed for reversing the motor.

THE SKEEN AUTOMATIC SEMAPHORE SIGNAL FOR ELECTRIC RAILWAY CROSSINGS.

THE volume of traffic and speed of electric cars in most large cities has long since made it desirable to afford those in charge of electric cars a means of knowing definitely the condition of the tracks at crossings and to meet this want the Skeen Electric Switch and Signal Co., of St. Louis, Mo., have recently brought out a signal equally adapted for day and night use. The signal is intended for use on all curves and railway crossings, and also on all street crossings where traffic is heavy or where fast time is made by the cars. On single track roads it may be used as an automatic block system. Our engraving Fig. 1 shows a perspective of a signal for use at a four track crossing, with the casing partly removed, exposing the interior and working parts, and Fig. 2 is a detail of the locking device showing the means by which the semaphore is held in position.

Fig. 3 is a diagram showing the connections for a crossing of two single track railways and Fig. 4 is a perspective view of a crossing of two single tracks.

Referring to Fig. 1, it will be seen that the signal is divided into two compartments; the upper one containing the working parts which operate the semaphore, and the lower one containing the signal lamps. This lower compartment is also divided in two sections, and fitted with lights with colors alternately arranged, as shown.

This signal is operated by a series of solenoid magnets, A A^1, the cores of which magnets are connected by the connecting rod F F^1 to the crank H, which is fastened immovably upon the shaft E, extending through a bearing out through the casing and to the outer end of which is fastened the semaphore B. On the inner end of the shaft E is fastened the lamp contact bar C^1. When the current is passed through either of the solenoids A it raises the semaphore D, which is normally horizontal, into a vertical position. This action also turns the contact bar C^1 against the contacts C, thus lighting the lamp in one of the compartments below.

The signal is held in the position into which it is turned by the locking device shown in Fig. 2. In this figure the current has energized the coil A and raised the semaphore D from a horizontal into a vertical position. The connecting rod F^1 which has a slot G^1 is passed through an aperture in the base and is held down by the shoulder I^1. It will be seen that it is impossible for the wind or other outside influence to turn the semaphore D back into a horizontal position, as the lower extremity of the connecting rod F^1 will tend to move in an arc struck from the centre E as shown by the dotted arrow, and be prevented from moving by the shoulder I^1. When, however, the current energizes the solenoid A^1 and the core B^1 is lifted, the slot G^1 allows the connecting rod F^1 to rise above the shoulder I^1 and be released, as shown by the full arrow.

When the semaphore D is in a horizontal position the magnet core B will be down and the connecting rod F will extend through the aperture I, and the pin in the crank H will be at the upper end of the slot G, thus locking it in the same manner that it is locked in a vertical position; thus a positive lock is formed for both positions of the semaphore.

Referring to Fig. 3, it will be seen that the car moving toward the west has passed the contact pan L, and by so doing has caused the current to pass to the ground through the coil A which operates the signal, stopping the south bound car by the warning semaphore and red light. The contact bar C^1 is thus turned against the contact brushes C which give current to the lower lamps, thus showing red to the south bound car and green to the west bound car. They will remain locked in this position while the car is passing between the pans L and M. When the car passes till the south bound car passes the pan M^1 at the crossing, when the signal will be returned to normal and locked.

For a crossing of single tracks but two pair of solenoid magnets and their corresponding semaphores and lights are required;

Fig. 1.

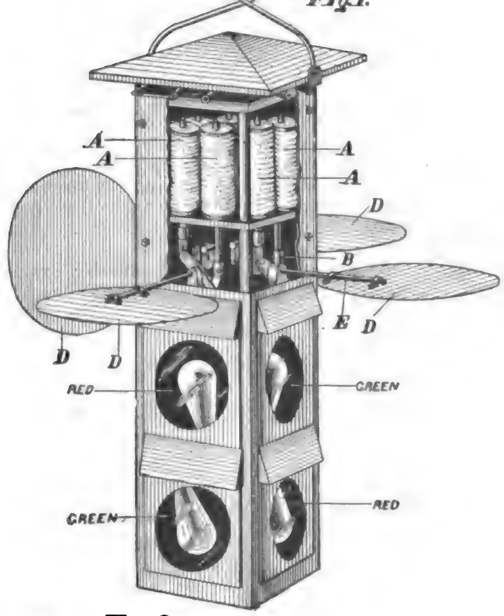


Fig. 2.

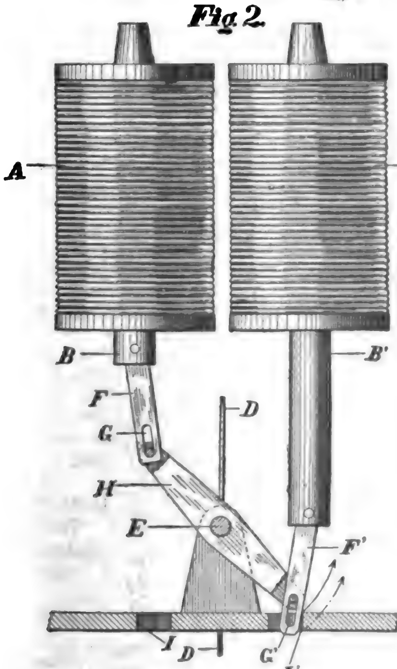


Fig. 3.

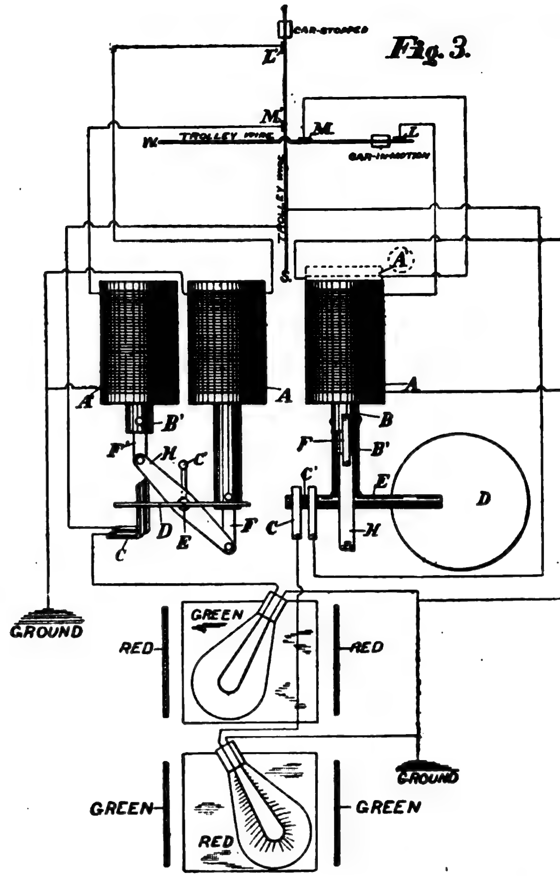


Fig. 4.

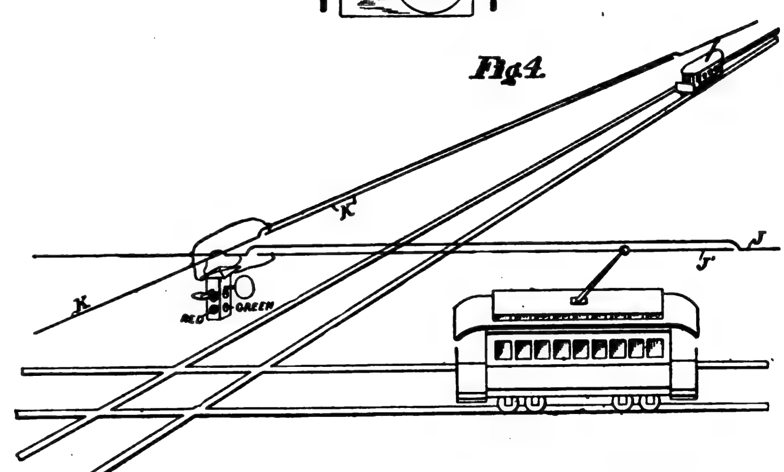


Fig. 5.

FIGS. 1, 2, 3, 4 AND 5.—SKEEN AUTOMATIC SEMAPHORE SIGNAL FOR ELECTRIC RAILWAY CROSSINGS.

the trolley contact M the semaphore will be turned to its horizontal position by the current passing about the coil A^1 to the ground, thus breaking the lamp contact by removing C^1 from contact with the brushes C. After the west bound car has passed the pan M at the crossing the south bound car will have right of way and proceed, and making contact with the pan L^1 will cause the semaphore used for blocking the east and west track to assume a vertical position, and the lamp in the upper compartment to be lighted, showing a red light to west bound cars and a green light to south bound cars. This warning position will be maintained for the crossing of a double track railway four pair of operating solenoid magnets and four corresponding semaphores; but the same number of lights as before are required. Fig. 1 shows such a signal adapted for double track crossings, but the diagram of Fig. 3 is used for simplicity.

A trolley contact or pan especially adapted to operate with this signal is shown in Fig. 5. It consists of a bar upon which is suspended a set of branching springs overlapping one another and approaching, but not contacting with the trolley wire. The bar is insulated and electrically connected with its proper solenoid A

or A¹. The trolley passing along the trolley wire contacts by its groove with these branching springs and sends a certain and continuous current to the solenoid magnet without impeding the passage of the trolley.

Referring to Fig. 4, a cut-out feature is shown as combined with the signal, which enforces the warning given by the latter. It consists of an insulated section interposed in the path of each trolley wire and extending from the crossing to a suitable distance away from it, and corresponding with the distance between the trolley contacts previously described. Each insulated section is wired to a switch operated by the same shafts E and cutting the current in and out of the corresponding section in the same manner as the lights are cut in and out, and simultaneously with them. Thus when the car going east reaches the insulated section J¹ it will cut out the current from the insulated section K¹ of the crossing line, at the same time that it presents a warning signal to that line. Should the motorman of the south bound car disregard the warning of the signal and endeavor to proceed he would find, upon running on the section K¹, that his car was without current until the east bound car had passed the crossing and restored the signal and cut-out switch to normal again. This safety feature enforces the warning of the signal and renders it impossible for a collision to occur through the carelessness and inattention of the motorman who has not the right of way. It is not a necessary feature of the signal, however, since it may be used with or without the cut-out switch, as circumstances may dictate.

THE TRAFFIC DECREASE ON THE NEW YORK ELEVATED.[1]

It is not often in a growing city that a means of travel receives a great check, or shows a large decrease in the number of its patrons. Yet this is what has happened in New York with the elevated railways. Our contemporary, THE ELECTRICAL ENGINEER, of New York, states that whereas in the year ending June, 1894, the number of passengers was 202¼ millions, in the next year it had fallen to but little over 187½ millions, a decrease of over 15 millions, though in the same time the surface or tram roads had carried over 80 million more passengers. Our contemporory urges the employment of electric traction to enable the elevated lines to compete with the surface roads. We are quite of opinion that the increase in the surface roads is due to mechanical traction, but we should doubt the benefit of electrical traction on the elevated roads so far as getting back the lost traffic is concerned. The present service may, perhaps, be increased, and that will tell for something, but the great objection is the climbing of steps, and the use of elevators, if such can be arranged as suggested, may prove useful, for it is undoubtedly the steps up from the road which constitute a great inducement to passengers to take the surface cars rather than the quicker elevated cars. In neither is it easy to secure a seat, unless a change has been made of late years, and for short distance traffic it really is hardly worth while climbing up and down stairs, and many people will walk rather than do so. We have fought shy of the stairs ourselves many times in New York.

Estimating the cost of converting the elevated system from steam to electricity, our contemporary sets it down at $5,000,000, which, in 6 per cent. bonds without sinking fund, would require $300,000 of an annual charge, and money could scarcely be had under 6 per cent. in view of the road's pre-existing obligations. If the lost 15,000,000 passengers could thus be regained, the income would be increased $750,000, thus putting the road $450,000 to the good by the change, and our contemporary thinks that by means of electricity, longer trains, or more frequent short trains, better lighted and better warmed, would secure the desired end. But we should ourselves be disposed to lay great weight on the suggestion of elevators. We do not think the public care much whether the trains are run by steam or by electricity; at least, not that section of the public which uses the trains. The man in the street may prefer electricity, because he won't get so much hot water down his neck, or dust in his eyes, but the traveller will welcome electricity chiefly because of the elevators. Indeed, it is not easy to see how the headway can very well be made less than what the 6th Avenue trains have already been run upon.

Some years ago an investigation into the advisability of converting the New York elevated roads to electric traction was made, with the result that the change was not held to be warranted; but it is probable that the case for electricity was not put in the best light, and to-day the question is probably to be considered very differently in the light of later experience, and we think it cannot be long before the change is made. We still think that the passenger traffic will require more than this to keep it up to its level, or again increase it, and if this is to be effected by elevators, there will need to be something smart in this line to fill the need. The rush of passengers at the busier hours will prove a severe test of any system of elevators for which there is sufficient room in the limited space available about the stations.

1. *London Electrical Review*, Nov. 8, page 562.

ELECTRIC LIGHTING.

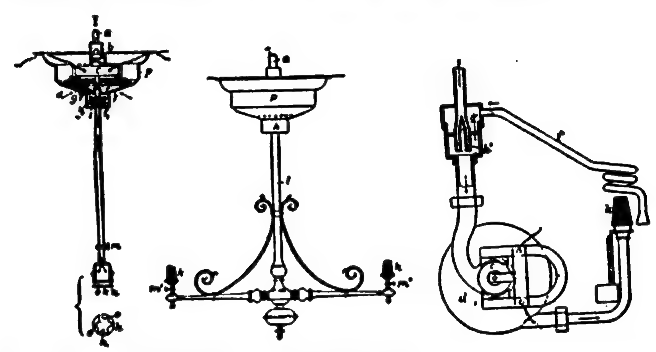
INCANDESCENT LIGHTING BY GAS AND ELECTRICITY IN COMBINATION.[1]

BY LOUIS DENAYROUZE, ENGINEER, OF PARIS.

As long as gas was the sole means of illumination for cities and important industrial establishments all propositions for the improvement of the burner by a more effective utilization of the gas were met only with distrust. This situation, however, has been altered since electricity, which has for some time seriously endangered the future of illumination by gas, has been utilized as a source of light. The rapid spread of the incandescent gas-light in the last few years quickly destroyed the fears raised by the electric-light, and to-day it is already recognized that gas is maintaining a successful fight with electricity, as well in quality of production as in reference to intensity of illumination. This remarkable means of illumination, however, should by no means be allowed to drop entirely, even if it is no longer the exclusive source of lighting, but may be combined with advantage, by reason of its dynamic peculiarities, with illumination by gas.

This line of thought forms the foundation for the present invention, which is distinguished by the combination of a gas-burner with a ventilator which sucks in the air necessary for combustion and which is driven by means of a little dynamo or magneto motor; which in turn is fed by an electric current brought through wires laid along the gas-fixture.

In my design, as is evident from the illustrations, the electricity is used as an aid in the supply of air, and its work, as is explained further on, is to mix the same thoroughly with the



FIGS. 1, 2 AND 3.—THE DENAYROUZE GAS AND ELECTRIC BURNER.

gas in order to solve most completely and economically the problem of illumination by incandescent gas-light. The accompanying cuts illustrate two forms of the device in question.

Fig. 1 is a vertical section through a design provided with only one burner, while Fig. 2 gives the elevation of a two-armed gasolier. The gas is let in from above through the pipe a where it passes through the hollow spindle b of a little motor driven by electric current. Below the motor c is placed a ventilator d whose fan-wheel e is rotated, whereby the outside air is sucked in through the opening f and driven into the magazine chamber h through the passage g. The hollow spindle b has its lower end projecting into this chamber which is provided at this place with the holes f through which the gas enters the chamber h. On this lower end of the spindle b are placed discs i which rotate with the motor c and so intimately mix up the gas streaming out of the supply pipe and the air brought in by the ventilator. This combustible mixture now flows through the pipe l provided with a cock m to the burner k, which is constructed preferably of refractory incandescent material. In Fig. 1 it is represented as a starshaped plate n. The combustible mixture flows to this star—made, for instance, of magnesia—through a large number of holes o which are suitably arranged in the form of a star. This star can be replaced as shown in Fig. 2, by wicks, stockings, or baskets made of similar luminous and durable material.

All the rotating portions of this design—the electric motor, ventilator, and mixing device—are enclosed in a casing p. The cock m (Fig. 1) as well as the cocks m' (Fig. 2) can be operated electrically so that the ignition and extinction of the burners can be operated automatically.

The experiments which have been made with the above described design have led to a similar and perceptibly better means for the supply of combustible mixture—that is to the simultaneous sucking in of air and gas by means of the ventilator. This arrangement is shown in Fig. 3, partly in elevation and partly in vertical section. The important improvement consists in the arrangement of the ventilator d and the little electric motor c between the point of mixing of air

1. From the *Austria-Hungarian Illustrated Patent-Gazette*.

Cities.	Kind of current.	Globe.	Current in amperes.	Mean width of streets in metres.	Mean distance from post to post in metres.	Mean height of lamps in metres.	Total number of arcs.
Paris, Grand Boulevards	Continuous	Opaline	10	35	40 to 60	5·95	313
„ Clichy Avenue	„	„	10	25	50	4·45 to 4·95	
Toulouse	„	„	10	14 to 15	50 to 70	7	222
St. Petersburg, Newski Prospect	„	Roughened	11 and 12	50 to 60	40 to 70	10·50	80
Milan	„	Opaline	4·5, 6, 10, 15 and 20	8 to 30	40 to 60	9	341
Hamburg, Jungferstieg	„	„	8	16	25 to 30	8	68
Berlin, Unter-den-Linden	„	„	14·15	16	41 (2 rows) 60 (1 row)	8	185
„ Leipzigerstrasse	„	„	14·15	16	60 (1 row)	8	
Berne	„	„	12	15 to 20	60 to 80	9	42
Munich	„	„	5 and 10	15 to 25	50	8 and 10	780
London, City	„	Small opal globe in clear glass lantern	10	...	...	6·50	479 (City 340)
Londonderry	„	Opaline	10	15 to 25	70 to 100	7·60	170
Glasgow	„	„	10	...	40 to 55	5·20	101
New York, avenues	„	Clear glass	10 to 11	30	78	6·10	2,621
„ cross streets	„	„	10 to 11	18	90		
Chicago	„	„	9·6 to 10	20, 22·5, 24·5, 30	60 to 100		1,486
Atlanta	„	„	10	9 to 30	23 to 30	7·60 to 12	416
Le Havre	Alternating	Opaline	12 to 15	30 to 45	70 to 80	4·50, 5·50, 7·50	77
Clermont-Ferraud	„	„	12 and 20	...	35	6	15
Zurich, Quai du Lac	„	„	18	30 to 40	60	7	53
Cologne	„	„	10	7 to 10	45 to 60	7	13
Blackpool	Continuous and rectified	„	10 and 10·5	25	45 to 50	7·6	185
Bristol	Continuous Alternating	„	10 13	15 to 30	40 to 50	6·70 3·65	97
Yarmouth	Continuous Alternating	„	10 15	... ...	... ...	6·70	60
Portsmouth	Rectified	„	12	...	80	7·60	100

TABLE SHOWING METHODS OF STREET ARC LIGHTING IN EUROPE AND AMERICA.

and gas and the true burner k. The construction of the admission chamber is plain from the cut. The gas enters in fine jets, as in an Argand burner, through the openings of a mouthpiece h' while the air is brought in through the conical tube i'. Mixing is started in the first place by the active sucking of the ventilator and is completed inside the ventilator by the movement of the fans operating upon the masses of gas and air.

In order to indicate the significance of the success of the results attained, it is sufficient to state that this design, with only an inconsiderable velocity of the ventilator wheel, reached the intensity of one Carcel lamp (9 English candles) with a consumption of 0.247 to 0.282 cu. ft. of gas, and that this consumption was reduced, at a higher speed, to 0.176 cu. ft., and indeed, with the help of regenerative combustion, to a still smaller quantity. The economy attained is consequently from three to four times that of the best gas-burners.

It is evident that the ventilator may bring about the desired mixture by the most various means (such as wings, scoops, screw-wheels, etc.). The construction and principle of the design makes possible the increase in the most simple manner of the economy offered by the generative combustion. For this purpose it is sufficient to provide the suction openings of the ventilator (Fig. 3) with a tube l' which can be carried above the burner in the form of a spiral. If it is desired to carry the re-heating very far, it is only necessary to use the ordinary gas-lamp chimney in combination, above or below, with a tube crown and to draw in the air through this.

An effective illumination can also be attained with this design by means of an increase of oxygen and hydrogen supplies. Thus, since the electric current driving the motor can supply at the same time the 3 volts necessary for the electrolysis of water, it is plain that the mixture of gas and air can be enriched by oxygen and hydrogen, as the nitrogen contained in the atmosphere ordinarily absorbs, unused, a considerable portion of the heat developed. For this purpose it is only necessary, to gain a marked enrichment, to dissociate the necessary amount of water by means of the electric current in the vicinity of the burner; in which case the necessary precautions for the avoidance of explosions are, of course, to be observed.

THE TENNESSEE CENTENNIAL EXPOSITION.

The Tennessee Centennial Exposition will comprise twenty main buildings of from 40,000 to 125,000 square feet area, in the centre of which will stand upon a terrace an exact reproduction of the famous Parthenon at Athens with an heroic statue of Minerva before it. These main buildings will contain a vast array of curiosities, arts, manufactures and resources of the world. All the walks will be constructed of asphalt. On the grounds there will be lakes, one of fifteen acres, a running stream and an overshot water-wheel; at least five specially attractive fountains, one operated by electricity and four designed by artists of wide reputation and many smaller ones. The electrical effects will embrace the latest inventions in displays, among them being a crown of incandescent lights revolving upon a steel tower 800 feet high and spelling the words "Tennessee Centennial, 1896."

STREET LIGHTING BY ARC LAMPS.

UNDER the above subject, M. André Blondel, in the *Génie Civil* gives an extended treatise on the above subject from the standpoint of the illuminating effect of the arc lamp. Thus he enters into the discussion of the proper heights of lamps, their distribution as determined by the width of streets, etc. The accompanying table embodied in M. Blondel's treatise furnishes some valuable data for comparison of the methods adopted in different cities here and abroad.

THE ELECTRIC LIGHTING OF EDINBURGH.—II.

BY HENRY R. J. BURSTALL.

THE arrangement of the switchboard and conductors is as follows: The feeders enter the building at a cellar under the pavement on the west side, and are brought along the wall under the platform in the form of heavy copper rods, which are carried on insulators, and pass up through the floor to their respective terminals at the back of the switchboard, and are attached to the terminals at the top of the board by cones and nuts. They are connected, through a duplex fuse and an ampere-meter, to heavy vertical copper bars on the front of the slates, each bar having three holes in it, through which plugs can be inserted. The leads from the dynamos are carried in the form of insulated cable to their respective terminals at the back of the board, near the bottom; and through fuses, automatic switches and ampere-meters are connected to vertical copper bars fixed to the front of the slates, similar and parallel to the feeder bars. The automatic switches are so constructed that the switch, after being closed by hand, is held in place as long as the current flowing through it exceeds from 15 to 20 amperes; should it fall below this, a trigger is released and the switch is automatically opened, thus breaking the circuit and preventing damage if a machine should fail from any cause.

The feeders under ordinary circumstances are all connected to the top omnibus bar, and are all in parallel. In order to connect any dynamo to the feeders, plugs are screwed into the top holes of the vertical bars corresponding with that dynamo, the brushes of the machine are put down upon the commutator, and the stop valve of the engine is fully opened so that the engine is running on its governor; the switchboard attendant regulates the electromotive force of the machine until it is equal to that shown on the voltmeter between the top bars, and then closes the automatic switch, putting load on the dynamo by taking resistance out of its field circuit. During the whole time the machine is on circuit it is regulated by the switchboard attendant, the engine running on its governor with the stop valve full open; the engine driver has to attend only to the running of the engines and dynamos. For the sake of economy, however, the engines are run somewhat slower at low loads than at full load; after about three-quarters of the full load has been reached, the setting of the governor is altered, and the engine run at full speed. In order to take the machine off circuit, resistance is put into the field circuit until the

current falls so low that the automatic switch opens; the driver then lifts the brushes out of contact, and shuts down the engine.

Balancing Machines.—The foregoing description applies only to the high-volt-machines; the connections for the balancing machines are somewhat different (Fig. 2). The leads for each of these dynamos are connected—through fuses, ampere-meters, and automatic switches, as for the high-volt machines—to two contacts of a double-pole switch on the centre panel; and can be connected alternatively with two or three contacts, one of which is connected to the middle wire and the other two to dynamo bars on the positive and negative sides of the switchboard respectively. Thus each balancing machine can be put between the middle wire and either the positive or the negative side of the switchboard. These machines are run in exactly the same manner as the high-volt machines, and the whole of their regulation is done from the switch platform.

Battery.—In ordinary circumstances the two outer ends of the batteries are plugged on to the top omnibus bar on the positive and negative sides of the switchboard; but can be disconnected either by removing the plugs or by the emergency switches. One of the cells near the inner end of each battery is connected with the middle wire through the regulating switch. Save under exceptional circumstances, however, the electromotive force of the whole battery in series would be much too high for the circuit; and therefore by means of a regulating switch any number up to twenty-six of the inner cells of each battery can be put in parallel with the inner cells of the other battery, thus keeping the electromotive force of the battery the same as that required at the omnibus bars to which the feeders are connected. When the dynamos are running, the battery-regulating switch can be set so that no current is passing into or out of the battery: putting more cells in parallel will lower the electromotive force of the battery, which will then be charged by the dynamos; while putting fewer in parallel will raise the electromotive force of the battery and cause it to discharge and thus to help the dynamos. Under normal circumstances the battery is charged while the load is light, more or less current being put into the battery as the load on the external circuit varies so as to keep the engines running at that time as fully loaded as possible. During heavy load the battery is kept as far as possible with no current going either into or out of it; only after the dynamos are stopped is it discharged at all heavily, or when the load suddenly rises, and then only for short intervals. This method of regulating the battery by putting the centre cells in parallel, which is due to Mr. B. M. Jenkin, necessitates connecting up to the regulating switches more cells than the usual arrangement of regulating by cutting out cells on the outer ends of the batteries; but its renders the manipulation of the battery much more simple, and does away to a great extent with the somewhat troublesome charging of the back cells, that is to say, the cells at the outer end of the batteries, which also in the usual arrangement may be used for only a few hours or even only a few minutes in the day, while they have always to be charged and kept ready for work.

Battery Connections.—The connections to the battery may appear somewhat complicated, but in actual work the regulation of the battery is effected by moving only one wheel like a steering wheel, fixed on the middle slate of the switchboard. The switches themselves are placed in the battery room above, and are worked by wire ropes from the wheel below. A special circuit and switch is provided, by which the cells that are in parallel can be charged independently of the rest of the battery; but in actual work this is not regularly used. In this arrangement of battery regulation the whole of the cells in the battery are always used, but the centre cells are not charged or discharged to such an extent as those which constantly remain in series. By properly choosing the time of charging, the regulating cells can receive rather more charge than they discharge; and in order to enable the charging to go on at light load, when there is only a small drop on the feeders, the "hospital" or "milking" cells are connected up, four on each side of the system, through two small switchboards on the switch platform. By suitably arranging the switches these cells can either be put in series with the main battery, or be put between the dynamo charging the battery and the feeders; in the latter case part of the current goes to the battery and part onto the circuit. The electromotive force of the dynamo charging the battery can thus be made higher than that required at the station end of the feeders; and the battery can be charged with more of the regulating cells in series than would be possible if it was in parallel with the circuit. This arrangement has the additional advantage that full use can be made of the hospital cells, which are usually standing idle unless any cell in the battery requires assisting. When used for this last purpose, the hospital cells are cut entirely off the circuit, and are put, two in series, in parallel with any cell which shows signs of weakness during the discharge of the main battery; connections are made from the hospital-cell switchboards in the engine room to terminals in the battery room, and adjustable resistances and amperemeters are put into each of these circuits, so that the current passing from the hospital cells to the weak cell can be regulated, and is always under control of the switchboard attendant.

Battery Room.—The battery room is directly over the west end of the low-tension engine room (Fig. 1), and is reached by a spiral staircase directly from the switch platform. It has a fireproof floor covered with acid-resisting asphalt, and is well lighted and ventilated, having windows on both sides of the room, as well as a ventilator in the ceiling. The battery consists of 132 cells of the new Crompton-Howell 31-plate type. It is divided up into two half-batteries, positive and negative; and is arranged in two tiers on four rows of stands, which are of cast-iron, with wooden longitudinal bearers carrying the cells; the eight hospital cells are arranged on separate stands. All the cells are similar, and have each a nominal capacity of 1,000 ampere-hours, the normal rate of discharge being 200 amperes. They are contained in lead boxes, and stand on glass oil insulators upon the longitudinal wooden bearers. The 26 cells in each half nearest the middle wire are connected up by solid copper rods with the regulating switchboard, which stands directly over the main switchboard below. Provision is made for a second battery of similar size, should it be necessary in the future. In the battery circuit there is a registering ampere-hour meter between the outer end of the battery and the switchboard, so connected that its pointer goes backwards on the dial during the charging of the battery, and forwards during the discharge. The mechanism is such that the pointer is 10 per cent. slow on the charge; thus, if the pointer is always brought back to zero by charging the battery, 10 per cent. more current will be put into the battery than is taken out. The battery has ample capacity to meet the whole of the load of the station from daylight till the evening; thus during the summer time it can do the lighting during more than half the whole 24 hours.

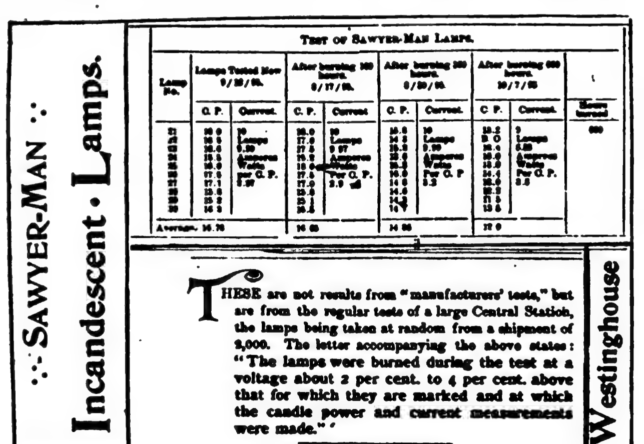
ELECTRIC LIGHTING AT ST. PAUL, MINN.

Mr. W. M. Stewart, the general manager for the Siemens & Halske Electric Co., for the Northwest, has informed the Retrenchment Committee of St. Paul that his company will put in a plant and light the city on a ten year contract, with 2,000 C. P. arcs at a cost not to exceed $75 per arc per year. He estimated that there was an opening for 600 arcs of 2,000 C. P.; 600 of 1,200 C. P. and 10,000 incandescents of 16 C. P.

LETTERS TO THE EDITOR.

DATA SHEET SUGGESTIONS.

Your publication and Data Sheets continue to interest me greatly, but I have a little suggestion to make. At times advertisers in your columns bring before the fraternity, efficiency tests and data of their respective apparatus, such as lamp tests, storage battery curves, etc. Would it not be a good idea to set such information in a form that could be cut out of the "ad" and readily made into the same size as your "Data Sheets"? To my mind, such is of importance to engineers and purchasers for ready reference. It would induce advertisers to bring out more about their manufacture, and be in a proper form for preservation, as I



imagine that many subscribers consign the advertising portion of a journal to the waste-paper basket, when getting it bound.

I enclose a sheet that I have made from a recent "ad" of the Westinghouse Co.'s published lamp test, and you will see that such takes considerable time to make it uniform in size with the Data Sheets.

H. C. CHAMP.

TORONTO, ONT.

WE reproduce herewith the slip enclosed by our correspondent. The lines show the manner in which the sheet has been pieced together in order to make it up to the standard size of the Data

Sheets. The reproduction is, of course, reduced in size. The suggestion is a good one and is well worthy the attention of all those towards whom it is directed.—Eds. E. E.

A REMARKABLE EXAMPLE OF PREVISION.

We are apt to assume that in such an art as electricity the advances are rapid, and that the changes undergone from year to year are radical. It is true that the industrial development is great, but might it not be urged that in the great fundamental principles, the perception of them is early and thorough?

This has surely been the history of electric lighting, and the writer submits in parallel columns the conditions of the lighting art as applied to large cities in 1880 and 1895, as proof of the remarkable prevision exhibited by Mr. Edison fifteen years ago and of the remarkable adherence to-day to the principles he then laid down. It would seem that the period intervening has been occupied in filling up the programme thus laid down so long ago.

1880.	1895.
In 1880 Edison said that the successful electric lighting system of a large city must have the following essential features:—	In 1895 we see both in the United States and abroad:—
1. Engines and generators, *direct connected*, in order to economize space and save losses in belting. Witness the "Jumbo" steam dynamos.	1. Standard practice of to-day. The Jumbos have been succeeded by vertical, triple or quadruple condensing marine engines, with generator armature on each end of the shaft.
2. All conductors *underground* to avoid troubles from the elements, contact with other wires, etc., and to forestall the day when cities would compel *all* wires to go underground.	2. Standard practice of to-day. The Edison tube system used in all of our large cities.
3. The *3-wire system* of distributing conductors to economize in cost of copper.	3. Standard practice of to-day, on alternating (secondary circuits) as well as direct current circuits.
4. The use of a number of feeders, tapping a system of secondary mains at many points, in order to maintain constant pressure (maximum variation allowed, 2%) on mains.	4. Standard practice of to-day.
5. The *low tension*, *direct current*, system, for all large cities where population is dense, on account of safety in handling circuits and avoidance of electrical complications on same.	5. Standard practice of to-day.
6. The subdivision of light into small units, each unit operating in "multiple arc" with every other, from the same system of mains.	6. Standard practice of to-day, both for incandescent and arc lamps.
7. The use *of a high resistance conductor* (or filament) enclosed in a *glass globe, highly exhausted*, as the only practicable form of incandescent lamp.	7. All incandescent lamps of to-day are made after Edison's original conception. The present Edison lamp has no equal.
8. The availability of secondary mains for attaching various forms of translating devices.	8. The uses to which the Edison low tension mains are put are being constantly extended for operating arc lights, motors, electroplating, electrolytic work, etc., etc.
9. The development of a *complete line* of necessary wiring and *safety* devices, such as cut-outs, sockets, safety fuses, switches, etc.	9. While great improvements have been made in the *mechanical* details of these devices, the standard Edison devices and fittings of to-day are made under the *original patents* and are the best in the world.

S. Dana Greene.

New York City, Nov. 20th, 1895.

ELECTRIC PLOWING.

I have for years been of the opinion that it is the duty of the U. S. Government to appropriate say $50,000 to make experiments in the application of electricity to agriculture, more especially to plowing. I propose to make it my business that an organized attempt shall be made at Washington this winter to obtain such a sum as competent electricians may deem necessary; and shall more especially see that the Irrigation Companies of the West, which have such large amounts of land unplowed and such vast quantities of water power running to waste, shall use their influence in that direction. I have already had a very favorable response from the Rio Verde Canal Co. of Arizona. The *Irrigation Age* of Chicago will be found in hearty sympathy, and I feel assured that The Electrical Engineer will not be found wanting. I have been saying for several years that I could see no reason why the same power which drives a heavy street car with sixty passengers, or more, could not also drag a plow.

E. W. Baker.

Barry, Ill., Nov. 13, 1895.

POSTAL TELEPHONY.

Referring to articles which are going the rounds of the newspapers in which the writer's name is connected with the Government plan to take up the question of Postal Telephony, I beg to advise you that in some cases insinuations have been cast upon the low rate per message calculated. Of course time will bear out the writer's position, he is confident. However, in order to verify to some extent his position, it may be in place to state that in a number of European places the total toll line telephone rate exacted for the five minutes' conversation is five cents. This was adopted by a recent rule in Berlin, within a fifteen to fifty mile radius, I have forgotten which.

The writer is confident that Postal Telephony will, within the period of his activity of public work, be as economical for messages as the Postal service of to-day.

J. E. Keelyn,
President Western Telephone Construction Co.

Chicago, Nov. 18.

MR. HARRINGTON BLOWS A FUSE.

Mr. James H. Bates' letter in "The Electrical Engineer" of Nov. 20th, is more interesting to me than mine was to him as he agrees with me that magnetic circuit breakers are a necessity as would be implied in his statement, "The magnetic circuit breaker is essential in a case like heavy railroad work or any other work where a circuit breaker controls a large volume of current."

Mr. Bates makes light of the fuse protection to jaws of switch to prevent blistering of the contacts, and to emphasize this triviality (?) he more prominently identifies himself in favor of magnetic circuit breakers as the following statement shows:—"To weigh such a comparatively trifling (?) matter against so great an advantage as pointed out is extreme folly, for what does a little blistering amount to compared with the safety of apparatus?"

What Mr. Bates seems to think an insignificant matter, and as he states "may be remedied by proper design," has been the opinion of several engineers with whom I have discussed the matter of magnetic circuit breakers. Yet why is it not done? The answer is simple. I have been three years reading papers based on practical tests of different kinds to demonstrate the gross untrustworthiness of fuses. Engineers at large are wedded to the old time fuses. Only a month ago in conversation with one of the most prominent electrical engineers in the East, he stated positively, as his opinion, "he did not see wherein anything was gained by using magnetic circuit breakers on a railway switchboard let alone on cars."

He further stated that a fuse and a magnetic circuit breaker of equal capacity would in event of a short circuit permit the passage of the same volume of current. As long as our prominent engineers keep ignorant of the practical behavior of fuse metals [I would here refer to Prof. Stine's and associates' paper on "Behavior and Rating of Fuse Metals," read recently before the A. I. E. E.] just so long magnetic circuit breakers will not be used generally.

I felt, when I prepared a paper on the behavior of fuse metals on 500 volt short circuits, that when it would be presented to such an august body as the A. I. E. E. that it would be taken in the spirit presented. But when such engineers as Prof. Elihu Thomson, C. P. Steinmetz and others lost sight of the salient facts contained in the paper and discussed methods employed and in some cases praised fuses, well !! The only engineers who by their discussion showed a realization of the facts were Prof. Crocker and Captain Brophy.

Here and there an engineer stands out in favor of magnetic circuit breakers for general use. I might mention Dr. Cary T. Hutchinson, C. O. Mailloux, Mr. Tapley of the U. S. Printing Office, Mr. Chas. Hewitt and others. In conclusion I must add one more name to the list—Mr. James H. Bates.

Walter E. Harrington.

Camden, N. J.

Mr. E. H. Mather, superintendent of the New Haven, Conn., Street Railway Co., writes us: "Although not favorably impressed with your Data Sheets when they were first issued, I have since learned that they contain much valuable information for engineers. Enclosed please find sixty cents for which send morocco filing case."

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CONTENTS.

THE VICTORY OF THE STORAGE BATTERY.

UP to within a short while ago the mention of the words, storage battery, to the average electrical engineer in the United States was calculated to produce much the same effect as the waving of a red rag in front of a bull; and even to-day this much-abused piece of electrical apparatus never fails to call forth discussions, frequently of unamiable character. The announcement of "Storage Battery Applications" as the subject for a topical discussion before the American Institute of Electrical Engineers was therefore well calculated to bring out a goodly number of contributions; and the result proved the wisdom of the selection. It was indeed time for a representative body like the Institute to take up the subject and thrash it out for the benefit of the profession and to place the storage battery in its proper light before the community. An examination of the contributions, part of which we print in this issue, shows that there is still lurking in the minds of some the impression that the storage battery is a piece of apparatus requiring an inordinate amount of care and attention beyond the ability of the average station manager. It is time, we think, that for the sake of their own good names, American electricians should cease this selfreproachful condemnation. Are we to infer, indeed, that American station managers are so far below their European confrères in intelligence and perseverance? Will the men who have shown the world what can be done with the electric current in lighting and power transmission longer permit the stigma of incompetence to rest upon them? We hope not. Indeed we think we discern most hopeful signs for the future in the recent work in this country. The results of one such experiment, if it can now be so designated, was most graphically and tersely put before the Institute by Mr. C. L. Edgar, of the Boston Edison station, than whom there is no more intelligent, progressive and conscientious station manager in the country. We regret that Mr. Edgar's contribution was not given out for publication in time for insertion in this issue, but if any doubts still remain in the minds of any as to the value of the storage battery, listening to Mr. Edgar's contribution must have dispelled them. Designedly leaving out all matters of a speculative or controversial character, Mr. Edgar confined himself strictly to the recording of his actual experience with the batteries in the Boston station after a year's use. That record, showing as it does, not only the economy in coal consumption by the use of the battery, but the enormous facilities which it puts into the hands of the central station operator, to provide for all possible conditions of working, together with the relief from mental strain which it affords, is a complete answer to every argument which has thus far been brought against the storage battery. The only point on which Mr. Edgar did not fully and flatly declare himself was that of depreciation, on which, as a conservative manager he rightly did not feel warranted in committing himself after only a year's use of the battery. But with the manufacturers' guarantee as to repairs and renewals, this item becomes fixed at once and enters into the calculations even before the battery is installed.

We have of late heard much of other methods of storage in connection with central station work, prominent among them being that of "thermal" storage. This system, and some others, certainly presents advantages in economical working, but after hearing Mr. Edgar's contribution, it is apparent that no apparatus other than the storage battery can give that flexibility which is requisite for meeting all the demands that may and do come swiftly and suddenly upon a central station and its connecting links.

Apropos to the Institute discussion is the renewed

attempt to place storage battery traction in this country on a practical basis; and the description of the New York Madison Avenue Line equipment which we print elsewhere in this issue will show that substantial progress has also been made in this field of storage battery application.

FUNDAMENTAL LIGHTING CONCEPTIONS.

Mr. S. Dana Greene favors us this week with a brief but sweeping presentation of the claims of Mr. Edison to foresight in the art of lighting cities by electricity. This terse letter is really a remarkable proof of the manner in which a gifted man may arrive intuitively at an early grasp of the fundamental problems and their solution in the new industry to which he is devoting himself. But it seems to us that Mr. Edison would have deserved little credit if he had not, in addition to "scheming" things, also devoted his genius and energy to the perfection of the various details rendering the ideal possible, practical and commercial. And this brings us to a fair comment, that neither Mr. Edison nor any other man, great as may be his share, can rightly claim the whole of a vast new art. Many workers and thinkers contribute, in differing degree and measure, but each with a right to some portion of the credit and reward. Moreover, it is a plain fact that while convinced as to the right lines of work, Mr. Edison has often swung around the circle seeking the best means, and has virtually abandoned not a few pet theories and productions. This is not a criticism, but rather a laudation, for no man can accomplish much whose path is not also strewn with failures, from which he has pressed on toward successes.

DETROIT LIGHTING FIGURES.

A STATEMENT has been most widely circulated to the effect that, thanks to its new municipal plant, Detroit is now getting its arc lights at $7.08 per month, or $84.96 per year; whereas under the old contract system the city paid $11.15 per month. This is heralded as a wonderful argument for municipal plants.

To repeat what we have often said before, we have no prejudice against municipal plants, although entertaining a strong conviction that any business of this kind is a good thing for city, state or nation to keep out of. In the particular instance, we are inclined to believe that Detroit has a very good plant and a good manager of it in Mr. Dow. But how unfair to private companies the above figures are, and how useless. Here are the details.

Coal	$1,418.50
Labor and Management	6,370.74
Carbons	740.30
Oil and Waste	107.00
Teaming	100.00
Globes and Nets	50.40
General Supplies	270.65
Printing and Stationery	25.66
Total for October	$9,083.25

To this is added the interest on $600,000 of bonds, making $2,000 per month for interest. Now this is the basis for the statement that Detroit is saving $4 per lamp per month. But it strikes the observer at once, that there is absolutely no mention in the table of three big items, to say nothing of smaller ones. In the first place, we find no allowance whatever for depreciation! Next there is apparently no charge for water, which is used in pretty large quantity and for which a private company would pay. Thirdly, there is no mention of the taxation that a private company pays, and which therefore in the case of Detroit is so much out of the city's pocket. Moreover, we do not detect any allowance for rent of offices and various other details that must come in somewhere, and which are none the less because the city does not happen to pay them under the specific head that needs to have a good showing made for it as an excuse for the investment. We must confess we do not see where the superior cheapness of the Detroit lighting comes in.

We mention this because it is a typical case of the way in which some of our excellent municipal plant friends rush away with the idea that they have solved the problem of cheap lighting, when they have not got half the items of expense and maintenance. Moreover, only a few days ago we saw in a Detroit paper a long account of a "stormy interview" between Mayor Pingree and the lighting commission because the plant could not furnish some more lighting that he wanted. This brings in the point that extensions and renewals are often necessary, aside from wear and tear; and we could name offhand several plants that have been torn down two or three times inside of ten years in order the better to meet changing conditions. Detroit is absolutely without prevision for such contingencies which a private company has always to bear in mind if conservative and prudent.

SURFACE ELECTRIC TRACTION FOR NEW YORK.

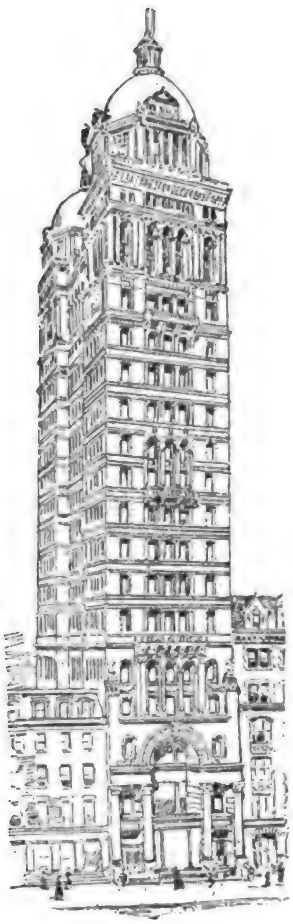
THAT New York city should be on the eve of having a complete system of surface electric traction, after years of lagging behind the rest of the country, seems almost too good to be true. A more important announcement could hardly be made, for aside from the magnitude of such work it must necessarily have a marked influence on the elevated or underground roads, both as to engineering methods and as to commercial results. It is true that the information comes from Mr. John D. Crimmins, who is always very cheery and optimistic where excavation work on a large scale is concerned, and who recently favored the public with some wonderfully roseate figures of the economies effected with the Lenox avenue sub-trolley system. But the statements of Mr. Crimmins are this time far more definite and are corroborated by the language used by his associates; so that there is good reason to see in the remarkable programme he has laid down a fair picture of what is actually to be accomplished in the next four or five years by the alert, progressive, well managed and public-spirited corporation known as the Metropolitan Traction Company.

As a matter of fact, the electrical plans put forth include the sub-trolleying of all the Company's arterial lines running north and south, including even Broadway itself in due course; and even before Broadway is equipped its cable cars will be picked up as trailers by the motor cars on the other lines, old or new, such as Sixth and Eighth Avenue, West Broadway, and the Belt Line. These lines, all sub-trolleyed, will be crossed at proper intervals, such as Bleecker street, Fourteenth, Twenty-third, and so on, by other sub-trolley lines; and in this way New York will have a very complete electric traction system without a wire in it showing above ground.

It is obvious that such a development means the expenditure of vast sums of money, and that much of it must go in the purchase of electrical and street railway apparatus. There is good reason to believe it will be a first-class investment, for even discounting Mr. Crimmins' more sanguine statements, it is evident that the Lenox Avenue road is doing well from a financial standpoint and that the cars are running with great regularity, although the fact that the power plant is still underloaded prevents any real data as to economy from being obtained. Another good feature of this work is that other methods besides the open conduit are to be tried; and we are glad of this as it promises to add to the list of feasible ways of applying electricity to the traction necessities of large cities, whether here or in other parts of the world.

Telephony and Telegraphy.

A NEW BUILDING FOR THE COMMERCIAL CABLE CO.



Commercial Cable Building.

It might reasonably have been supposed that when Mr. John W. Mackay put up the superb Postal Telegraph Building on Broadway, for the headquarters of his telegraph company, and as a home for the offices of the Commercial Cable Co., his ambitions and ideas in the line of office buildings would have been accomplished and gratified. This is not the fact, however, as the Commercial Cable Co. is now to have a separate and distinctive headquarters of its own. Plans for a million-dollar office building, which the Commercial Cable Building Company intends to erect in Broad and New streets, adjoining the New York Stock Exchange, have been completed by the architects, George Edward Harding & Gooch, who also designed the Postal Telegraph Building.

The drawing herewith shows a handsome and imposing twenty-one story structure, above which rise two towers surmounted by domes representing the two hemispheres. The towers will be connected by a mansard roof more than three hundred feet above the street level. On the domes the Old and New Worlds, joined by the cables of the Commercial Cable Company, will be shown in relief.

The general style of the building is the Italian Renaissance, the elevations being worked out in light moulded and plain brick with terra cotta ornaments of the same tones. Marble will probably be used for the columns of the lower stories. The foundations will be built on caissons sunk to the solid rock. The beams, girders, columns, roof trusses, etc., will be of steel and wrought iron, and the beams will be filled in with fireproof bricks. The floors throughout the building will be of concrete or mosaic.

The architects were instructed to provide an absolutely fireproof building, regardless of expense, and they have done so by eliminating from their specifications wood and other combustible material. Even the window frames will be of copper or similar metal, and the inside trim of doors and windows will be fireproofed. The roof will be completely covered by fireproof tile and the cornices and the cupolas of the domes will be of copper.

The interior of the building will embrace every improvement and the finish will be the best. Lavatories and retiring rooms will be provided on each floor. Six fast electric elevators will furnish adequate transit to the upper stories. Two handsome entrances from Broad and a similar number from New street will give access to the first floor, which will be of unusual height. This floor will be furnished entirely in marble and will be occupied exclusively by the Commercial Cable Company, the large corridors extending from Broad to New streets excepted. The top floor will have an unsurpassed view of New York city and its harbor and will probably be leased to a bankers' club. The remaining nineteen stories will be rented for offices. The ground cost the Commercial Cable Company more than a million of dollars a few months ago, so that the total investment in land and structure will represent an outlay of at least $2,000,000. Trinity steeple is 284 feet high, while the cable company's new building will be 305 feet high from the curb level.

THE PACIFIC CABLE.

All of the colonial agents in London except the representatives of West and South Australia had a conference with Mr. Joseph Chamberlain, Secretary of State for the Colonies, last week, with the result that Mr. Chamberlain agreed to appoint a Commission to arrange the details of the construction of the proposed Pacific cable. The imperial Government, Australia, and Canada, will each appoint two delegates upon the Commission, which will proceed with its work as soon as possible.

The representatives of Cape Colony and Natal were present at the meeting, and Mr. Chamberlain remarked that the presence of representatives of colonies having no concern in the project in its present form was an evidence of solidarity and sympathy. He expressed the opinion that the project showed a fair prospect of remunerative return upon the capital required.

It was arranged that the colonial Governments should nominate delegates to the Commission, whom the imperial Government will confirm, as the Commission will consider and report upon the whole subject in all its aspects.

THE THERMOPHONE.

In the Newport, R. I., gas and ice factory use is made of an instrument called the "thermophone," for determing the temperature at different points in the gas holder tanks. The apparatus, shown in Fig. 1, was designed by Messrs. Henry E. Warren and George C. Whipple. It resembles the Siemens' pyrometer and takes advantage of the fact that different metals have different electrical temperature-coefficients. The accompanying diagram, Fig. 2, illustrates the general arrangement.

A and B are coils of different metals placed in proximity and joined together as shown in the figure. These coils are connected with a slide-wire, CD, by means of the leading-wires L and L[1]. The two ends of CD are connected in circuit with a battery M. A galvanometer, G, is put into a leading-wire connecting the junction of A and B with a movable contact, y, on the slide-wire. The galvanometer will indicate zero current when $\frac{A}{B} = \frac{Cy}{Dy}$. But A and B, having different temperature-coefficients, will vary in resistance at different rates with changes in temperature; consequently there will be a different value of $\frac{A}{B}$ for every temperature. The value of $\frac{A}{B} = \frac{Cy}{Dy}$ may be directly read from a scale placed under the sliding contact, y, or the temperature corresponding to the given ratios of $\frac{A}{B}$ may be marked upon the scale.

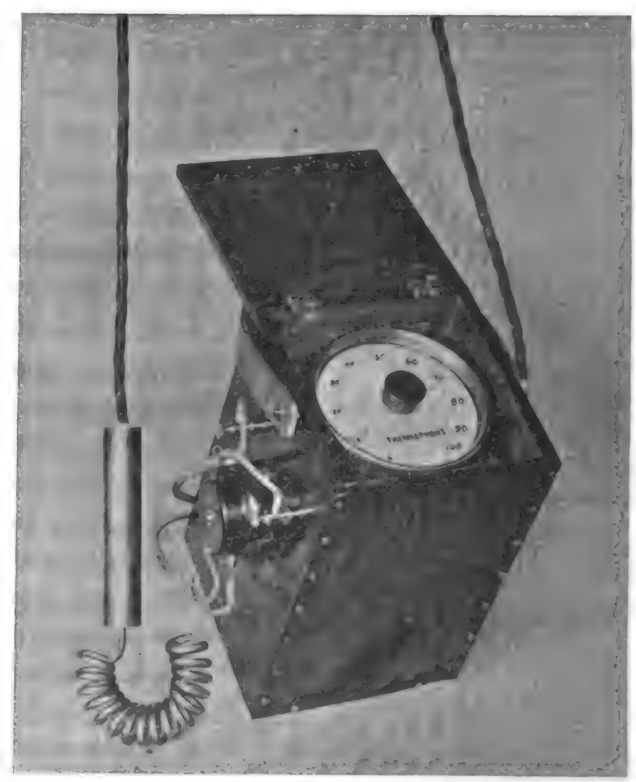


Fig. 1.—The Thermophone.

In practice the slide-wire is wound around the edge of a disc above which there is a dial graduated in degrees of temperature. The hand on the dial is directly over the movable contact on the slide-wire, and both are moved by turning a knob in the centre of the dial.

It is easily seen that the temperature of the slide-wire CD, has absolutely no effect upon the reading of the instrument, for being made of one piece of metal, which has the same temperature throughout its length, each portion of it will rise or fall in resist-

ance at the same rate with changes in temperature; consequently the ratio of its parts will not vary. The effect of temperature changes on the leading wires L and L[1] will not sensibly affect the readings for the same reason.

In place of the galvanometer it has often been found advisable to use a telephone, in connection with a circuit-breaker, to show the presence of a current. It is in this form that the instrument is illustrated here. The coil having been placed in the position

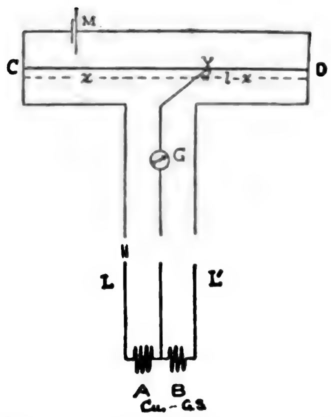


FIG. 2.—DIAGRAM OF CONNECTIONS OF THE THERMOPHONE.

where the temperature is desired, the transmitter is taken from its hook on the left-hand side of the box and held to the ear while the right hand of the operator turns the knob over the dial until a point is reached where no sound is heard. The dial-hand then indicates the true temperature. If desired, a number of coils can be located permanently at a number of distant points and thrown into connection with a central dial-box, at will, by means of a little switch-board. We are indebted to the *Progressive Age* for the illustrations.

THE TELEGRAPH HABIT.[1]

"All sorts of cranks in the world," said the girl in the telegraph office of a Broadway hotel, "but I think the telegraph cranks are the queerest. Against the rules of the office to give away our business, you know, but a body can generalize. Do you know there are lots of men who have the telegraph habit? It is like the cigarette habit or the drink habit. When it once fastens on a man it is seldom he ever breaks himself of it till he's 'broke' himself. That's a poor pun, but it's true. If it wasn't for the telegraph crank we wouldn't begin to do the business we do. You'd be surprised to know the money some men dissipate in telegraphing on any and every excuse.

"All sorts of state secrets go over the wires, and important affairs are transacted by telegraph every day, besides the usual routine of deaths and weddings, and business orders, and women starting on journeys notifying their friends to meet them at the station. But the regular telegraph crank comes into the hotel and rushes into the office here and telegraphs half a dozen of his friends: 'Arrived safely.' Next time, half an hour later, he wires them to address mail to him here. Shortly after that he advises them that he forgot to notify them that he will leave New York on Monday. After a while he changes his mind and wires that he will stay till Tuesday. The next morning he worries because he has not heard from home, and wires them to ask if anything is the matter. He gets a letter by noon and wires again to say that the letter came safely by the next mail and he will answer by the afternoon post. Maybe you think I exaggerate, but I don't. Why, in a week a telegraph crank will often give me his entire pedigree and most of his family secrets.

"A lot of men do their love making by telegraph, and a lot more do their joking with business friends in the same way. Any amount of chaff goes over the wire at regular tariff rates. Some men have a fad for sending wedding congratulations and death condolences by telegraph to great people who probably never heard of them. Egotism is at the bottom of most of this particular kind of insanity. The man thinks it makes him look important to rush into a telegraph office as soon as he strikes the town and dash off a message.

"Then some men are nervous, and it somehow acts as a sedative to let off steam on a telegraph blank. I hate a 'Have you sent it?' 'How long will it take to get there?' 'How soon will I get an answer?' And men of business and common sense who ought to know better, ask those same questions over and over again.

"The way people write telegrams makes me smile. I know a millionaire who will work for five minutes to get what he has to say in ten words for a quarter. But usually people write around Robin Hood's barn when they begin a telegram and use twice as many words as necessary. Women are the worst for that, but very few men or women seem to understand the art of brevity.

"Another funny thing is that telegrams, usually written in a hurry and sometimes under stress of great excitement, are literary curiosities in the line of spelling. 'Funeral' is one of the words that is a stumbling-block to the mourner. 'Until' is another hoodoo word. You would be surprised at the orthography of the average American in a hurry. You learn lots of things in a telegraph office, but you have to keep your mouth shut. Oh! a body can generalize, of course."

1. *New York World.*

POWER TRANSMISSION.

EXISTING COMMERCIAL APPLICATIONS OF ELECTRICAL POWER FROM NIAGARA FALLS.[1]—II.

(Concluded.)

BY W. L. R. EMMET.

The apparatus consists in a transformer and a regulator. The former has a fixed ratio of transformation, being built for an E. M. F. of 2,200 in the primary, and 185 in the secondary. The regulator is virtually a transformer in which the mutual induction of primary and secondary is variable. Its design is somewhat similar to that of an induction motor, there being two concentric parts built of laminations with distributed windings in slots on each. The outer member is fixed, while the inner is movable through an arc of 60°. This angle corresponds to the space between two poles, the windings being so grouped as to form six poles. In addition to the regular windings the movable member is fitted with closed turns of low resistance between the poles, so placed as to prevent magnetic short-circuiting when the regulator is in or near mid-position, Thus the regulator is a transformer in which the inductive relation of the two coils is reversible, and in which the mutual induction is variable.

The connections of the transformer and regulator between the line and furnace are shown in Fig. 3. The regulator there appearing has, for the sake of simplicity, been shown with two poles only, and of Gramme construction, while six poles and cylindrical windings are in reality used.

The transformer and regulator are connected together and to the furnace by heavy copper bars, suspended above them from

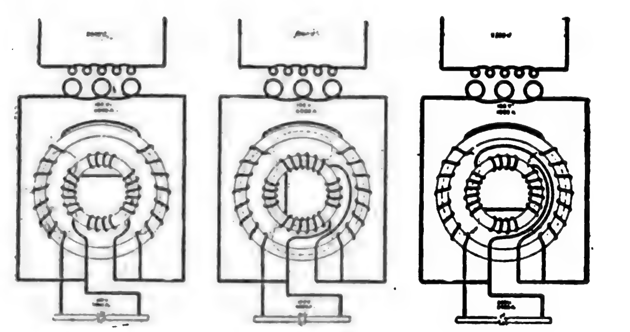


FIG. 3.

the roof of the building. The winding on the stationary part of the regulator is placed in series with the transformer secondary, and that on the movable part is in shunt. The conductors at different points are proportioned to the currents which they carry. Eight bars 4″ x ⅛″ of suitable lengths, give the desired arrangement.

At the beginning of the process the resistance of the furnace is at its maximum, the current from the transformer divides, part energizing the movable part of the regulator, the remainder passing through the stationary part of the regulator, the effective E. M. F. being thereby raised from 185 volts to 250 volts. From this position the regulator is gradually turned as the resistance falls, the result being that the added E. M. F. and the amount of current withdrawn from the circuit by the shunt portion of the regulator both continuously diminish. When the regulator reaches mid-position, the two parts have no mutual induction, and the regulator is entirely neutral except that the magnetizing current and losses of its two parts are supplied at the expense of the transformer.

As the regulator passes from the mid-position, the resistance of furnace continuing to fall, the E. M. F. generated in the stationary part begins to oppose the E. M. F. of the transformer, and the current in the furnace rises, being now the same as the currents from the transformer, and from the movable part of the regulator. The regulator is so arranged that it can be turned either by hand or by a motor. In the carborundum furnace the variations of

resistance are so irregular that a continuous angular motion of the regulator cannot be used. If the variation of resistance was uniform throughout the process, the regulator could be slowly turned by a properly guarded constant speed motor and would be automatic.

The transformer and regulator are cooled by circulating oil. A pump and two tanks are used, one above the other. The upper tank contains a coil of pipe in which water circulates. It is so arranged that the moving oil must flow over this coil and give up its heat. The lower tank receives the oil from the apparatus, and prevents an overflow in case the pump stops. In the transformer, the oil is admitted at the bottom and flows upward through and around the coils, the coils being placed vertically and the laminations horizontally. After overflowing at the top of the coil space, it finds its way downward over the outer surface of the laminations. The regulator is so constructed that it revolves in a horizontal plane. The cooling oil flows upward through the air-gap between the two parts, and down over the outer surface of the stationary part, and inner surface of the movable part. The transformer is placed in a cylindrical tank, while the regulator is self-contained, the cast-iron supporting shell forming the outer casing.

The oil is lifted by a small induction motor geared to a pump. Since the process is not continuous, some means of opening the circuits must be provided so that the apparatus may be cut out when the process is complete. The arrangements which have

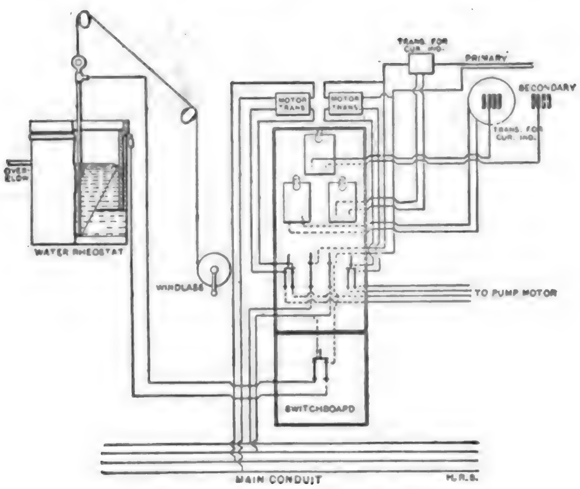


FIG. 4.

been made for this purpose are shown in Fig. 4. A pair of large snap switches is placed, one in each lead from the generating station. In parallel with one of these switches a specially designed water rheostat is placed. This rheostat consists of an iron tank lined by a section of vitrified pipe of large diameter. This tank is about half filled with water, and a pointed electrode is so arranged that it can be raised or lowered from the water by a rope leading to a small winch. Before the switch is opened, the electrode is lowered into the water, which provides a non-inductive circuit in parallel with the switch. After it is opened the electrode is raised, which increases the resistance till the circuit is broken at the surface of the water. The vitrified pipe prevents the possibility of arcing or contact between the electrode and the iron tank.

THE COMPARATIVE EFFICIENCY OF DRIVING ROPES AND BELTS.

Prof. D. S. Capper read at the last meeting of the Institution of Mechanical Engineers a paper embodying a translation of the "Report on the Lille Experiments upon the Comparative Efficiency of Ropes and Belts for the Transmission of Power," and his observations thereon. The author remarked that in almost all these experiments the chief object has been to determine the limit of load under ordinary working conditions, beyond which a belt will slip upon its pulley. By the Lille trials it has been shown that ropes are practically as efficient as belts, though some slight doubt has been cast upon the actual value as previously determined of the losses in belt gearing, from the fact that the variation which was found between individual observations at Lille exceeded 3 per cent. It is to be regretted, Prof. Capper added in conclusion, that it was not found possible with such a unique installation to extend the limits of the research; but it must be admitted that the difficulties were great, and the increase in the outlay would probably have been large.

N. KUMAGAYA, of Osaka, Japan, is investigating the subject of electric power and its transmission at Niagara Falls. He is there in the interest of the cotton spinners' association of Japan.

THE SIEMENS & HALSKE ELECTRIC MINING DRILLS.

THE Mining Department of the Siemens & Halske Electric Co. has recently added to its standard apparatus complete rock drilling outfits. These consist of percussion and rotary drills together with special motors for driving them and with the necessary auxiliary apparatus. These drills are the result of long experimentation by Siemens & Halske, of Berlin, whose engineer, Mr. Carl Hoffman, was the designer of the main mechanism of the percussion drill.

Our engravings, Figs. 1 and 2, represent the complete drilling outfits of the two types including the motor-box. In the original form the mechanism consisted of a crank motion, in which the crank is connected permanently by means of powerful springs with the reciprocating body. The elastic connection causes the stroke of the plunger to be larger than that of the crank; both motions are to a certain extent independent of each other. For

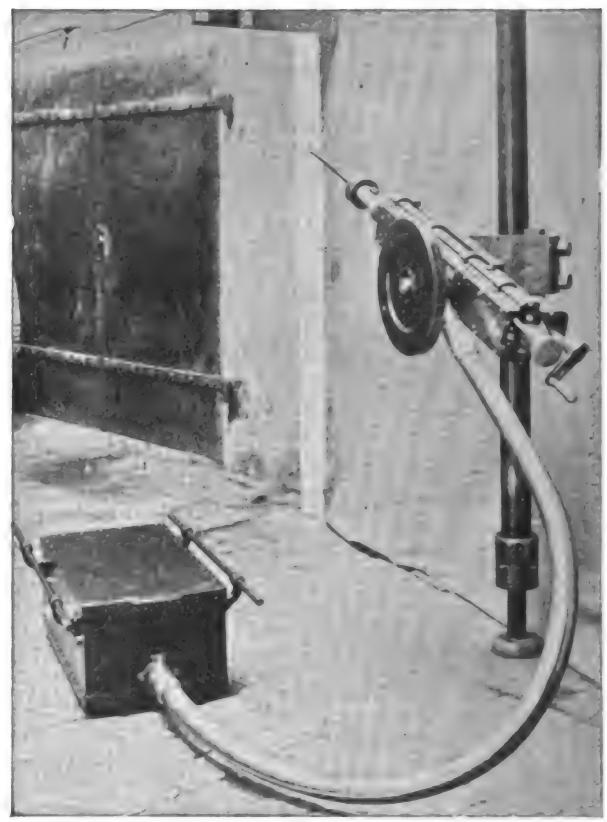


FIG. 1.—THE SIEMENS & HALSKE PERCUSSION DRILL.

instance, it is one of the practical requirements that the crank should turn freely even if the plunger should be arrested at any point of its stroke by the bit becoming fast in the bore-hole; such an accident may occur even in spite of the great retracting power of the machine. In later types, the mechanism of the machine has been modified and simplified considerably in accordance with the requirements of practice, while the principle has remained the same.

The most important part of the whole construction is the springs. It was first feared that they would not last long and would not stand the strains, especially in case of the wedging of the bit, but practical experience has dispersed these doubts; there are now springs which have stood successfully about 30,000,000 blows without breaking.

The firm of Siemens & Halske showed during the Frankfort Exposition, 1891, a mechanical percussion drill in operation, which proved to have a capacity of drilling per minute, holes about 35 mm. (1.4 in.) diameter, and from 25 to 30 mm. deep (1 to 1.2 in.). This result was obtained with a consumption of only 300 watts; and while the work has now been trebled, the consumption of energy has been increased to 980 watts only.

The interior arrangement of the motor box is shown in Fig. 3. To the left, externally, is a short T-pipe which serves as a receptacle for the lower end of the flexible shaft; a little further to the right are the gearing and the motor. On the right are the contact plug receptacle and the crank, and on a little bracket inside the box the safety fuse enclosed in a porcelain box which has a mate in the opposite corner of the box, not shown in the illustration. The rheostat face with contact points, which is inside

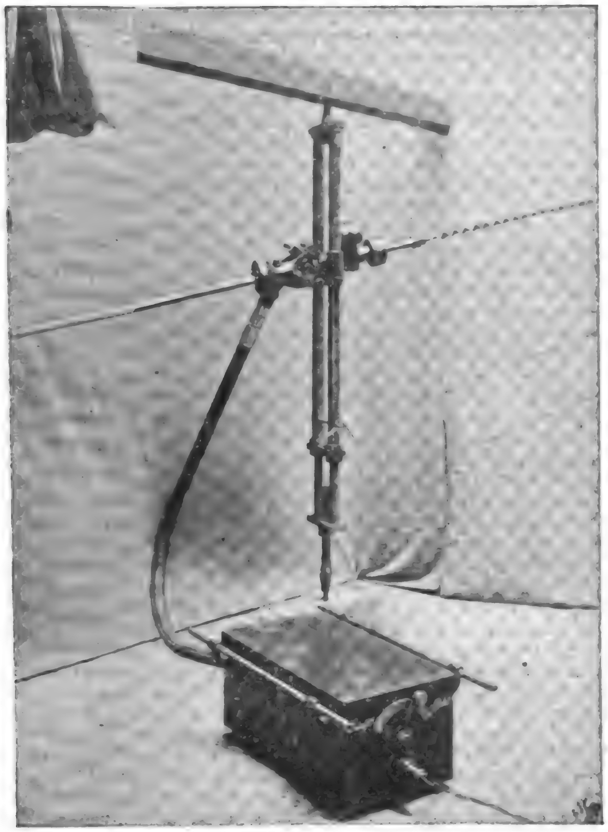


FIG. 2.—THE SIEMENS & HALSKE ROTARY DRILL.

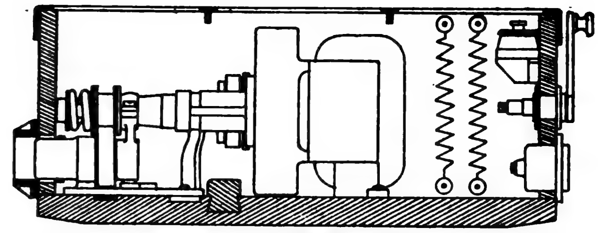


FIG. 3.—THE MOTOR BOX.

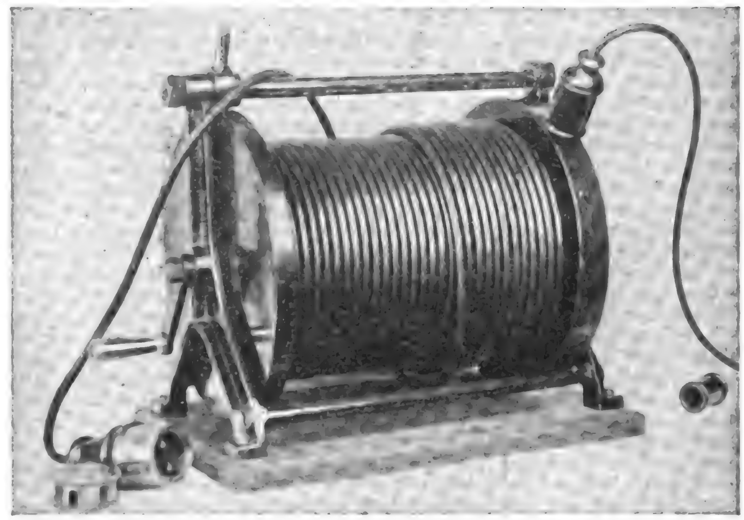


FIG. 4.—CABLE REEL FOR PERCUSSION DRILL.

of the box, is not shown; the starting resistance is indicated only by two coils. The weight of the complete motor-box is a little over 200 lbs., so that two laborers can easily carry it.

A portable cable drum, designed to carry 200 feet of cable, and shown in Fig. 4, also forms a part of the outfit. By its means connection can be readily made with the main conductors.

The latest type of the hand-feed percussion drill without fly-wheel weighs 180 lbs., and the detachable fly wheel, 40 lbs.

MISCELLANEOUS.

THE USE OF STORAGE BATTERIES IN ELECTRIC LIGHTING.[1]

BY DR. FRANCIS B. CROCKER.

THE function of accumulators is to receive electrical energy at one time or place and to give it out at some other time or place.

The principal uses to which they may be put in electric lighting are the following:

1. To supply portable electric lamps. 2. To take up fluctuations and thus steady the voltage or current. 3. To furnish energy during certain hours of the day or night and enable the machinery to be stopped. 4. To aid the generating plant in carrying the heavier load which usually exists for only an hour or two. 5. To make the load on the engines more uniform by charging the battery when the load is light. 6. To transform from a higher to a lower potential by charging the battery in series and discharging it in parallel, or *vice versa*. 7. To subdivide the voltage and enable a three or a five wire system to be operated with a single dynamo. 8. To supply current from local centres or sub-stations. Each of these applications will be considered separately in the above order.

1. *Portable accumulators.*—The accumulator is practically the only means of supplying electric portable lamps or those which are not connected to a dynamo even if they are stationary.

The primary battery is expensive and troublesome to operate and it has never been commercially successful for electric lighting, except where only a few small lamps are required. Nor is there any other satisfactory primary source of electrical energy except the dynamo driven by a mechanical power. It is therefore practically essential to adopt accumulators wherever portable electric lamps are used.

The serious drawback with portable accumulators is their great weight. For example, a standard size which weighs 100 pounds yields ten volts and five amperes or 50 watts for ten hours, which is just sufficient to feed one ordinary incandescent lamp of 16 candle power. This weight would be prohibitive in most cases in which the only way to carry the battery was by hand, but it might be allowable for lighting railroad trains where the weight would not be so objectionable.

Their great weight would also discourage in most instances the use of accumulators for supplying lamps in places which are not connected to a generating plant, the batteries being carried back and forth from a charging station. This method might be resorted to on special occasions, such as fêtes, to which ordinary commercial limitations do not apply, but for regular lighting it would be troublesome and expensive.

Small accumulators are used to feed miniature lamps for medical or dental purposes, in which case their weight is not a serious difficulty in view of the importance of the work and the small amount of energy required. Small batteries are also employed for theatrical lighting effects in which the lamps and batteries are carried by the performers when it is not convenient to supply lamps by a wire connection.

2. *Accumulators for preventing fluctuations*, due to unsteadiness in the driving power, are often applied successfully. A dynamo driven by a gas engine, for example, may vary periodically in speed because of the explosive action of the gas in the cylinder, and a battery connected in parallel with the dynamo will have the effect of steadying the voltage. But improvements in design and construction tend to reduce unsteadiness of speed and by the use of a heavy fly-wheel and an elastic connection between the engine and dynamo the result is sufficiently satisfactory in most cases to make a battery unnecessary. An accumulator is generally installed in connection with a small gas engine lighting plant to enable the engine to be stopped for a considerable portion of the time and save labor and attention, in which case the battery may also act to prevent fluctuations, but its principal function is the former one which will be considered next.

A windmill electric lighting plant, absolutely requires an accumulator or some other means of storing energy not only to eliminate fluctuations in speed which are constantly occurring, but also to bridge over the considerable periods of calm weather.

3. *Accumulators to enable machinery to be stopped* during certain portions of the day or night. The advantage of this application depends upon the fact that in almost every electric lighting plant there are long periods during the day and late at night when the number of lamps lighted is so small that it may not pay to run the generating machinery.

This plan also allows the machines to rest and cool down; which greatly facilitates cleaning and repair. In a hotel, residence, or on board of a yacht it may also be very desirable to stop the machinery and avoid the vibration and noise during the night. On the

1. A communication read before the Amer. Inst. Elec. Engrs., Nov. 20, 1895.

other hand, the addition of an accumulator to an electrical plant renders the latter heterogeneous, since the battery and its management differ so radically from the machinery and the handling of the same. It must also be remembered that the total investment is increased by the cost of the battery and its accommodation because the generating plant is perfectly able to carry the load put upon the battery since, by hypothesis, this load is a light one. Hence the machinery might be run all the time, in which case the battery would be entirely unnecessary and sufficient rest of the machinery could be secured by using different machines for the periods of light load on successive days. These statements are based upon the supposition that the battery is not used to help the dynamos at the time of maximum load since this case will now be considered separately.

4. *Accumulators to aid in carrying the maximum load.*—If accumulators are substituted for a certain portion of the dynamo capacity the question arises whether the substitution secures any advantage. In regard to first cost, authorities differ widely. These discrepancies probably arise from the confusion between K. W. hour and K. W. hour of output. Most accumulators have a normal time of discharge of about 10 hours hence the cost per K. W. hour is only one-tenth of the cost per K. W. of output, and this would, of course, vary with any change in the time of discharge. In many cases it is specious and leads to mistakes to speak of K. W. hours, to appreciate which fact we have only to realize that the K. W. hour capacity of a dynamo is almost infinite since it might run for twenty years. The actual K. W. of output, or in short, how many lamps can be simultaneously fed, is the question in electric lighting. Moreover, in most cases, the time of discharge of an accumulator is unnecessarily long, and this is particularly true when it is used to help carry the heavy load which usually lasts only one or two hours. In this case the remaining hours of available discharge are of little or no use. If it be attempted to discharge more rapidly, both the capacity and efficiency are seriously reduced, and in many types the condition and very life of the battery are injuriously affected by a high rate of discharge. What is needed for the maximum load or "peak of the load diagram" is an accumulator with a normal time of discharge of two or three hours and having a correspondingly smaller first cost, bulk and weight, that is, about one-quarter of those of the ordinary forms of battery. It is evident that the time of charging need not be made as short as that of discharging if it happened to be more convenient to charge more slowly.

The use of accumulators to enable the machinery to be stopped, which is a case already discussed, usually demands a time of discharge of from 10 to 14 hours, which agrees quite well with the normal discharge rate of the ordinary forms of battery, but even then the time is unnecessarily long since the average rate of discharge would rarely exceed one-half of the maximum rate. Consequently the battery would either be incompletely discharged or the rate would have to be made excessive at certain times.

5. *Accumulators to maintain uniform load on the engines.*—Steam engines are very inefficient at light loads. This inefficiency, in fact, is one of the chief sources of loss in an electric lighting plant and the principal object of the engineer who designs and operates a station should be to reduce this waste to a minimum. The accumulator is the most important means of accomplishing this result, although there are often methods such as gas, thermal (hot water) and steam storage all of which have been carefully compared by Mr. Nelson W. Perry in a paper before the National Electric Light Association, February, 1895, entitled "Storage of Energy Essential to Economy of Working Central Stations." Judicious selection of the number and sizes of the engines would enable them to be worked at a considerable fraction of their full capacity nearly all of the time, and it would seem that the same care that would be required to manage the battery might enable this to be accomplished. Nevertheless the accumulator gives more flexibility to the plant, and where introduced it often seems to considerably increase the economy of the engines by making their load more uniform and nearer their full capacity. According to the figures given by Mr. Perry in the paper cited above, an electrical horse power costs $48.68 per annum when developed steadily, and costs $117.78 per annum with a variable load similar to that of an electric light station, that is, the latter costs about 2.4 times as much as the former. This ratio seems very high, but is borne out by statistics[1] which give a very large coal consumption for most electric light stations. Under these circumstances almost any method of making the engine loads more uniform, should increase the economy of working. Doubtless an accumulator would benefit any plant in which an engine runs for any considerable portion of the time at less than half of its full power.

If a plant is so small that it contains only one engine it may be necessary to run it a great deal of the time far below its full load. But even with two engines it is generally possible to select the sizes so that the smaller one runs economically during the periods of light load, the larger one alone is suited to medium loads and both are used for the maximum output, the times during which any engine is very much underloaded being very short. With a greater number of units it becomes still easier to properly apportion the load and when there are five or more engines, as is usually the case in large stations, the loss from this cause should be trifling. To be sure the waste of energy which occurs from using boilers for variable loads still remains, but according to the figures given by Mr. Perry this is less than that due to the engines, and general experience shows this to be true.

6. *Accumulators used as transformers.*—If the cells of a battery are arranged in series while being charged and in parallel for discharging, a high voltage current will be required for charging and a low voltage current will be given out. The total amount of energy measured in watts is the same minus the loss of 15 or 20 per cent. which always occurs in accumulators. The result is similar to that obtained by an alternating current transformer or motor-dynamo. Such a method of transformation of potential might be employed in connection with long distance transmission of energy, the current being sent over the line at high voltage and converted to low voltage by accumulators for local distribution. For potentials of several thousand volts which are commonly employed in transmitting long distances, the number of cells required would be so great as to make this of doubtful practicability compared with the ordinary stationary or rotary transformers, but it would give uniformity in load and other advantages which may be secured by the storage of energy.

7. *Accumulators used for subdividing voltage.*—This application is similar in principle to the preceding. The most important practical case is that in which a dynamo of 220 volts charges a battery of corresponding potential, a three-wire system being supplied from the battery, the neutral wire of which is connected to the middle point of the battery. This arrangement avoids the necessity of running two dynamos and allows the battery to be placed in a sub-station near the districts to be supplied, so that it is only necessary to run two conductors to that point instead of three. The same principle may be applied to the five-wire system.

8. *Accumulator sub-stations.*—The plan of installing battery plants at local centres which are charged from the main station, enables some of the conductors to be saved in a three or five wire system, as already stated. It also makes it possible to reduce the size of these conductors because the current which flows over them can be kept practically constant, so that it is not necessary to have them large enough to carry the maximum current consumed by the lamps which may be several times the average value. This, of course, gives the same steady load on the generating machinery as if the battery were located near it.

The batteries at the various sub-stations may be connected and charged in series or in parallel. The former plan would require far less copper in the conductors, since the voltage is multiplied by the number of batteries in series and the current is the same as for a single battery. On the other hand, this high difference of potential would exist between the first and the last batteries of the series, and if one of those became grounded, any person connected to the earth and touching a wire supplied by the other battery would receive a shock due to the total voltage. This would demand that the maximum difference of potential should not exceed 500 volts, or, in other words, four batteries of 110 to 125 volts each might be charged in series and could be connected to the lamp circuits at the same time. This would practically amount to a five wire system using accumulators to subdivide the potential as explained in case 7. If the batteries were entirely disconnected from the lamp circuits while being charged, the latter would be free from danger of the high pressure which might therefore be 1,000 or 2,000 volts if desired, the batteries being charged during the day and supplying the lamps at night. For continuous working, two batteries would be necessary. Accumulator sub-stations not only save copper in the feeders but also reduce the cost of, and lost voltage in, the distributing conductors because the batteries can be placed near the lamps to be supplied with current.

Accumulators used for two or more of the above named purposes.—Each of the different uses of the storage battery has been considered separately to avoid the confusion with which this subject is often beset, but as a matter of fact the employment of the accumulator for several of these purposes is the most common practice. By thus combining these different applications the plant may be rendered not only more economical but also much more flexible. For example, the battery may be utilized to help out the generating machinery at times of heavy load or when the latter is partially or wholly disabled. It often happens that it is difficult to produce or maintain sufficient steam pressure owing to poor draught or other circumstances, in which event a battery enables the boilers to be temporarily relieved of some or all of the drain upon them while the pressure is being raised to the proper point. It may also be necessary or desirable to shut down the machinery or a portion of it for a few minutes to make some repair, adjustment or change of arrangement, connection, etc.

It is also possible to feed some of the circuits from the battery while the others may be supplied at a higher or lower voltage by the machinery. In these and many other ways an accumulator may be a very convenient adjunct to an electric lighting system. The fact that it is so radically different from the machinery in its nature and action makes it very unlikely that the entire plant

1. See Report of Committee on Data to National Electric Light Association. *Electrical World*, March 2, 1895, p. 273. (These statistics also appear in THE ELECTRICAL ENGINEER, Feb. 28, 1895.)

will be crippled at any one time, since the two sources of current are not exposed to the same dangers. An accident to the steam piping, for instance, might shut down all of the machinery but it probably would not affect the battery, and *vice versa* an accident to the latter is not likely to extend to the former.

THE STORAGE BATTERY FOR CENTRAL STATIONS.[1]

BY ARTHUR E. CHILDS.

In England and on the Continent, storage batteries have been used in central stations for more than five years, and the success of their application has brought about a great change of feeling regarding them; and the respect with which they are now regarded is an ample indication of the value they have been to managers in the operation of their stations.

It is an acknowledged fact that the great variations and fluctuations of the load on power circuits, especially those power circuits supplying trolley lines, are among the greatest difficulties which engineers have to contend against, and any appliances which will aid them to arrive at a satisfactory running of their station is looked upon with favor by them. It is only in the ranks of those short-sighted engineers, where ignorance and prejudice are the rule rather than the exception, that there are found men who will refuse to consider the storage battery as an auxiliary.

In this paper the term "variation" is used to designate the change of current induced by the adding of lights on to a lighting station, or the cars or motors on to a power station. The term "fluctuation" is used to indicate those rapid and necessary changes of current taking place on the outside line, due to stopping or starting of cars or throwing on or off of stationary motors. Although they may be thus differentiated, they bear a certain relation to each other, and in applying a storage battery a study of the conditions will quickly indicate the type of battery which will be more favorable in each case. By the "type" of battery is meant the slow discharge battery for a long period of service, or the rapid discharge battery for a few hours, or even less time of discharge.

In the lighting station, if we bear in mind the usual form of curve, it will be remembered that the instantaneous changes of current are minute and almost imperceptible compared with the steady increase or diminution of the total current of the station. Comparing the lighting curve with the usual form of power station curve, it will be noticed that the instantaneous changes of current are enormous compared with that in the lighting station curve. There is a similarity in the two curves is the fact that at certain hours of the day more cars are operated than at other hours, thus producing a general rise in the level of the power curve corresponding to throwing on of a number of lights in the lighting curve.

It is not the purpose of this paper to discuss the characteristics of the two curves, but to consider in a general way the application of storage batteries to the wiping out of the fluctuations and variations as they come upon the dynamos and engines. The introduction of a storage battery into a central station, acts in a certain sense as a buffer between the external load and the dynamos, taking the shock of the variations without throwing the same on the engines. In this regard they have the effect of reducing the average percentage variation in load on the dynamo from a large amount to a very small one, making the operation of the machines more efficient. In fact, a storage battery acts as a regulator in this instance, maintaining as it does a constant voltage at the switchboard. This introduces the question of the efficiency of engines with varying loads; and, leaving out of account the reports by engine builders, who are naturally interested parties, it is a fact that not many extended and careful investigations of efficiency under varying loads have been carried out. Prof. W. C. Unwin, of the Central Institution, at South Kensington, has shown, however, that a decrease of mechanical efficiency has a serious effect on the economy of working with a variable load, and with a load varying from 100 per cent. to 25 per cent., the efficiency decreases from 85 per cent. to 40 per cent.

As applied to power stations, and especially where water power is used, storage batteries are almost indispensable. The writer knows of several plants where the successful maintenance of a constant voltage on the machines is dependent upon the fact that an attendant sits by the governors of the wheels and regulates them by hand, as the inertia of the water, even when the best water-wheel governor that has ever been produced is employed, is too great to allow the turbines to pick up or throw off the load with anything like the quickness with which it is thrown on or off by the outside circuit. The stations in mind are not small stations, as might be supposed at first thought, but are stations where several thousand horse power and over are generated at certain hours of the day; and it is surprising that engineers of intelligence, who are usually quick to perceive the advantages of new applications, are still allowing their prejudices to prevent them from investigating the merits and value of accumulators as regulating governors in their stations.

In the application of storage batteries to the power station of a trolley system, it is not unusual to find the variation in load as much as 50 per cent. below the average horse power, and even as great as 200 per cent. above the mean load. These enormous fluctuations take place in the course of a few minutes, and are an expense to the railroad companies in at least three ways. In the first instance, they require the use of a dynamo capacity very much in excess of that required where the station is operated at a constant load. In the second instance, these fluctuations reduce the life of the machinery of the station, producing a very large depreciation account. In the third instance, the efficiency of the generating plant is very much reduced, as pointed out in a previous paragraph. It has been figured out in a number of instances that could the steam be utilized in a proper manner in the engines driving the dynamos, at least 40 per cent. more work could be obtained from it.

When considering the application of storage batteries to illuminating plants, it is found that their value is equally as great as in the case of power stations, as the charging of the battery can be done while the plant is operating at light loads, thus making use of the power of their machines to great advantage. At the period of heavy load, the battery is able to take care of the peak of the load, and also to operate the lights during that period of the 24 hours when few lights are being supplied from the station.

The value of an accumulator plant attached to an illuminating station has been thoroughly demonstrated by the New York Edison Illuminating Company, and the Edison Illuminating Company of Boston, and recently in the plant of the Lawrence Gas Company, Lawrence, Mass. In the latter case the battery is used in connection with their Edison three wire system, and is used in the regular way of carrying the peak of the load during the busy hours of lighting. A secondary use of this particular battery is that at noon when the large mills on the Merrimac at Lawrence shut down, they back up the water into the river above and entirely cut off the supply to the wheels of the gas company (for some 25 or 30 minutes) which are thus unable to operate the machines furnishing light and power until the overflow of water which is dammed back comes down and allows the station to be operated. This short period of absence of water is taken care of by the storage battery plant.

The storage battery can also be used as a valuable adjunct to both power and lighting stations at points in their systems where it is difficult to maintain the voltage at periods of heavy load. In these cases the feeders are usually not sufficient to carry the whole current direct from the station. But during the periods of small load the feeders can be utilized up to their maximum allowable drop in potential to charge battery sub-stations placed at these weak points. When the load at such points becomes greater than the capacity of the feeder, the battery comes into play and carries the load in connection with the station supply at that point, thus maintaining the voltage and doing satisfactory and valuable service. There must be hundreds of street railroads in this country that have just such weak points, and it will only be in accordance with the established progressive character of American street railway and lighting engineers to investigate the value to them of a storage battery as soon as it has been brought thoroughly to their notice. This cannot but result in a widely extended use of the storage batteries for this purpose; and the expectations of those interested in storage batteries would not be exceeded if half the street railroads and direct current lighting plants in this country and Canada should adopt within the next few years storage batteries either at their central stations or at sub-stations, the more especially as they can now obtain storage batteries which are thoroughly reliable and which can be installed under a guarantee.

The extent to which storage batteries have been used in England and on the continent is very great; and it will surprise many engineers in this country to know that there are more than 20 lighting stations and several thousand isolated plants in Great Britain alone, using storage batteries. Further than this, there are in Germany 5,000 isolated plants using storage batteries and 15 railway power plants. In fact, 80 per cent. of all the central stations in Germany and Austria are equipped with storage batteries. In addition to the above, there are many stations in France, Italy, Holland, Belgium, Sweden, Norway, Denmark and Spain, and two or three in Switzerland.

A survey of the progress which storage batteries have made in European countries, indicates no very great change in the principles of construction, but the results seem to be rather due to a thorough analysis and appreciation of the requirements of each case. This has resulted in a proper use of batteries and a correct recognition of the limitations of their usefulness. This fact alone has contributed largely to their successful application. The great difficulty in this country has been that engineers have not recognized a proper limit to the usefulness of a battery, but have, in many cases, far exceeded their specified limitations, and in this way have injured the batteries and cast discredit on them. It would be just as reasonable to overwork an engine until injured

1. Abstract of a communication presented at the meeting of the Amer. Inst. Elec. Engrs., Nov. 20, 1895.

or worn out, and then declare that all engines were useless and expensive mechanical contrivances.

One point which has contributed largely towards the success of storage batteries in Europe, is the fact the engineers have endeavored to obtain long life and high efficiency even at the expense of increased first cost and instead of attempting to obtain a large output per pound of element, they have limited themselves to a reasonable number of ampere-hours per pound. The result of this has been that the batteries in use in Europe have shown great endurance and solidity. The experience, however, which has been obtained with many American batteries has not been so promising as on the continent, owing to the lack of proper appreciation of them. It would be greatly to the advantage of American engineers if they would follow the lines laid down by their European confreres; and if, instead of waiting for some marvelous development in the manufacture of storage batteries, they should make use of the existing high class and efficient batteries which are now offered to the public, and by using them in a reasonable manner they would obtain valuable and even remarkable results.

Great progress has recently been made in manufacturing large batteries which have a capacity large enough to take care of the needs of central lighting and power stations, and engineers need no longer complain that they are unable to get the large cells which they require. In fact, manufacturers can produce cells having almost any given capacity.

Considering the efficiency of a storage battery, the factors which tend to reduce it are due to a loss in voltage and in the quantity of current. These losses, however, are not so serious as they have been in the past, and manufacturers are at present able to guarantee a very high efficiency. In cells which were submitted to Prof. H. L Callender, an ampere efficiency of 96.1 per cent. was recorded, the watt efficiency being 84 per cent. In certain instances, however, known to the writer, these efficiencies have been slightly exceeded, and complaints from central station managers that they cannot obtain efficient cells are now groundless, as with the efficiencies named, an eminently satisfactory service can be obtained. It must be borne in mind that a loss of 16 per cent., or even 20 per cent., in the efficiency of the battery does not mean the loss of the same percentage in the output of the station, as the battery usually supplies, approximately, or even less, of the whole output in watts-hours, and it is, therefore, from that fraction of the whole output that the loss in the battery must be deducted.

In the matter of cost of maintenance of a storage battery outfit, it is now usual for the manufacturer to guarantee a fixed annual percentage. This percentage varies from ten per cent. in small plants to a smaller percentage in large plants, depending, of course, on the conditions of operation and the use to be made of the battery, a study of which will soon determine what percentage can be guaranteed. In first-class plants well installed and operated by careful engineers, the cost of maintenance can be reduced to the vicinity of 3.5 or 4 per cent. It is customary for the manufacturer to enter into a contract, in the case of large plants, guaranteeing that the cost of maintenance shall not exceed a certain percentage per annum for the period of contract. This can be carried out in two ways. Either the lighting or railroad company can pay the manufacturer the percentage specified, every year, and the manufacturer will inspect and keep the battery in first-class condition; or the company employing the batteries can inspect and order renewals themselves, in which case, should the cost of maintenance exceed the percentage guaranteed, the manufacturer will not charge more than the specified amount. This is an exception rather than the rule, however, as the cost of maintenance is usually somewhat lower than that specified by the manufacturers, so that the company owning the battery is the gainer by the difference in percentage. By a thorough attention to details, both large and small, the percentage can be kept down to a very low figure; and it is to be regretted that the practice of engineers which prevails in Europe, of treating the battery with care and consideration, does not seem to exist among the engineers of this country, to the detriment of their own lighting or railroad plants, which would otherwise be able to utilize batteries in an efficient manner.

It must not be assumed from the above that storage batteries require an inordinate amount of care and trouble. On the contrary, they do not require either expense or great care. All that is demanded is regular and systematic attention on the part of those having them in charge. When such care is exercised, it is found that batteries perform a very valuable service, and largely reduce the operating expenses of the station—in many cases as much as 30 to 35 per cent. This reduction in operating expenses is, of course, due to the saving in cost of coal consumed, a saving which could not otherwise be obtained. Where water power is employed, a storage battery enables the water-wheels to be operated for 24 hours, storing current while the station output is reduced to a minimum, and aiding the station during the busy hours of the day. In many cases this practically doubles the output of the station without increasing the cost of installation to a corresponding amount. In fact, in many cases where water power is used it would be impossible to double the power of a station, as there would not be enough water at hand to give double the power. This is especially true in those sections of the country where the power of small streams has been utilized and where the flow of water is continuous but not very great. In addition to a storage battery acting as a receiver for storing the current while the station is not giving a large output, it also maintains, during the operation of the station, a perfectly uniform voltage, which would not be obtained with the varying load direct upon the water wheels, on account of the difficulty in governing previously mentioned.

When an entirely new power plant is to be built, there is no doubt by adopting the storage battery in the first instance, the initial cost of installation will be less than for the plant not using storage batteries, and the cost of operation of the station will certainly be very much reduced when the station uses storage batteries. In the case of existing plants which have to be extended, it has been proved that a kilowatt-hour capacity can be added more cheaply to the station by the addition of storage batteries than by the addition of generating machinery; while, of course, the cost of operation is much reduced.

Referring to the primary cost of storage batteries, the cost per kilowatt hour output is relatively greater for small cells than for large ones, since the cost of manufacture is reduced per kilowatt hour in the larger sizes, whereas the jars and tanks which are used to hold elements do not decrease very much with the decrease in size of the elements. The cost of shipment and erection are, of course, slightly less per kilowatt hour with the larger sizes than with the smaller ones, and on the whole the cost per kilowatt hour with the larger cells is less than with the smaller sizes. It is stated by the Electric Storage Battery Company that they are now installing large plants of the Tudor type at a cost per kilowatt hour of about $37 to $40, which cost, it is understood, can be reduced in the larger stations. The question of cost, however, is one which must be studied out in each case where it is proposed to install storage batteries, and a consideration of the cost of installation of storage batteries with their attendant reduction in operating expenses, will very soon bring to the mind of purchasers that it is cheaper to invest in accumulators than to invest in additional boilers, engines and dynamos.

As previously stated, it has been the object of this paper to bring before the INSTITUTE the general facts and considerations relating to the installation of storage batteries as auxiliaries to power and lighting plants. Lengthy descriptions of plants already installed have been avoided, and those interested are referred to the published descriptions which are constantly appearing in the technical journals.

SOCIETY AND CLUB NOTES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

AT the regular monthly meeting of the Council held at the rooms of the Institute, 26 Cortlandt Street, Nov. 20th, the following Associate Members were elected:—Wm. D. Ball, Consulting Electrical Engineer, Ball & Allen, 625 Monadnock Block, Chicago, Ill.; Eskil Berg, Electrical Engineer, Gen'l Electric Co., Schenectady, N. Y.; Chas. L. Brown, Student at Cornell University; residence, 6122 Drexel Ave., Chicago, Ill.; C. C. Burr, Electrical Engineer, Pittsburg Reduction Co., 701 Ferguson Block, Pittsburg, Pa.; Paul G. Burton, Constructing Electrician, Western Electric Co.; residence, 45 W. 127 New York City; J. Du Bois, Chief Electrician, Mohawk Division N. Y. C. & H. R. R. R., Albany, N. Y.; E. Friedlaender, Electrician, Carnegie Steel Co., Duquesne, Pa.; C. P. Gott, Chief Engineer and Electrician, Grand Central Palace; residence, 83 Washington Place, N. Y.; N. M. Hopkins, Scientific Literature, 1730 I Street, Washington, D. C.; A. S. Hubbard, Electrician, Alexander-Chamberlain Electric Co.; residence, 305 E. 34th Street, New York City; E. Maccoun, Ass't Supt. of the Electrical Dept., The Carnegie Steel Co., Munhall, Pa.; F. W. Phisterer, Graduate Student, Cornell University; residence, 84 Heustis Street, Ithaca, N. Y.; Erich Rathenau, Electrical Engineer, Allg. Electricitäts Gesellschaft, Berlin, Germany; A. K. Warren, Proprietor, A. K. Warren & Co., 465 Greenwich Street, N. Y.; residence, New Brighton, S. I., N. Y.; H. S. Webb, Instructor in Electrical Engineering, Lehigh University, South Bethlehem, Pa.

The following Associate Members were transferred to Membership:—A. Hartwell, Electrical Engineer, Westinghouse Elec. and Mfg. Co., Pittsburg, Pa.; Julius Martin, Master Electrician, Equipment Dept., New York Navy Yard; Joel W. Stearns, Jr., Treasurer, Mountain Electric Co., Denver, Col.; M. Oudin, Electrical Engineer, General Electric Co., Schenectady, N. Y.; L. K. Comstock, Electrical Engineer, Monadnock Bld'g, Chicago, Ill.; E. D. Brown, District Inspector, American Telephone and Telegraph Co., New York City; Fred A. La Roche, Vice-President and General Manager, New York Electric Equipment Co., New York City; J. J. O'Connell, Telephone Engineer, Chicago Telephone Co., Chicago, Ill.; F. W. Darlington, Consulting Electrical and Mechanical Engineer, Philadelphia, Pa.; F. V. Henshaw, Electrical Engineer, Providence, R. I.

At the meeting of the Institute at 12 West 31st Street, the

evening was devoted to a consideration of the topic "Storage Battery Applications." Communications submitted by A. E. Childs and C. L. Edgar, of Boston; F. B. Crocker and N. W. Perry, of New York, and Carl Hering, of Philadelphia, formed the basis of the discussion, which was participated in by H. Ward Leonard, E. T. Birdsall, J. B. Entz, J. Appleton, C. Blizard, Townsend Wolcott, J. W. Lieb, Jr., and others. This was the first experience of the Institute in the line of topical discussions and the result in New York was very gratifying. The attendance of members and guests was 115, and President Duncan deemed it advisable to call for an adjournment at 11 o'clock. The subject was also discussed at Chicago and San Francisco the same evening.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED NOV. 19, 1895.

Accumulators:—

Plate for Storage-Batteries and Process of Making It, F. J. Clamer, Philadelphia, Pa., 549,899. Filed Dec. 20, 1893.
Consists in enveloping a porous core or centre formed of oxide of lead with a porous metallic lead jacket.

Alarms and Signals:—

Automatic Electric Fire Alarm, H. A. Edgecomb, Mechanic Falls, Me., 549,906 Filed Jan. 5, 1894.
A combined push button and automatic electric fire alarm.

Electric Protective Appliance, A. H. McCulloch, Boston, Mass., 550,192. Filed Jan 24, 1895.
Consists of three carbon plates insulated from each other, two of the carbons being connected respectively with the sides of the main circuit, and the other being connected to the ground; and means for changing the contiguous surfaces of the carbons relatively to each other to dislodge accumulated particles.

Electric Time Signaling Apparatus, J. T. A. Todd, Fort Worth, Tex., 550,205. Filed Feb. 11, 1895.

Railway Signaling Apparatus, B. Wyckoff, Asbury Park, N. J., 550,210. Filed Mch. 18, 1895.

Cycle Alarm, R. McL. and A. McDonald, Dalmuir, Scotland, 550,229. Filed Apl. 6, 1895.
An electric bell and shocking-coil arrangement for the purpose of administering a severe electric shock to any person meddling with the machine and at the same time sounding an alarm.

Conductors, Conduits and Insulators:—

Insulated Pipe Coupling, E. E. Clift, Philadelphia, Pa., 550,097. Filed Sept. 20, 1894.

Dynamos and Motors:—

Electric Fan, P. Diehl, Elizabeth, N. J., 550,042. Filed May 11, 1891.
The fan blades are arranged inside of a rotating ring-armature with the field magnet located outside of the armature. The commutator is formed at the hub or central portion of the fan, and the fan blades are utilized as conductors between the commutator-sections and the armature.

Electrometallurgy:—

Apparatus for Extracting Gold, A. L. Eltonhead, Philadelphia, Pa., 549,907. Filed Jan. 15, 1894.
Improvement in details of the cyanide process.

Galvanic Batteries:—

Galvanic Battery, E. S. Boynton, Brooklyn, N. Y., 550,039. Filed Feb. 21, 1895.
The Boynton multivolt battery. For description see THE ELECTRICAL ENGINEER, May 15, 1895, page 453.

Electric Battery, T. Froggatt, London, Eng, 550,167. Filed May 1, 1895.
Details relating to a pocket battery.

Lamps and Appurtenances:—

Electric Arc-Lamp, E. Cannevel, Paris, France, 550,215. Filed April 20, 1893
Details referring to a brake lamp.

Measurement:—

Electrical Indicator, J. W. Howell, Newark, N. J., 549,919. Filed Jan. 2, 1892.
Consists in applying to the indicating-hand a retarder in the form of a coiled spring having an initial tension, which normally holds the indicating device at a predetermined or initial position with such force that the hand will not be moved by a current of low potential, but will only begin to move when a comparatively high electromotive force is present in the circuit of the instrument.

Miscellaneous:—

Expression Indicator for Self Playing Instruments, F. W. Hedgeland, Chicago, Ill, 549,916. Filed Feb. 23, 1894.
An indicator adapted to convey to the operator knowledge as to when the pedals or other expression controlling devices should be put into operation.

Self Propelling Vehicle, Boat, &c., G. A. Washburn, Cleveland, Ohio, 550,008. Filed Mch. 6, 1895
The driving shaft is driven either by engine direct, or the engine drives a dynamo to charge storage batteries that later furnish current for driving the dynamo as a motor.

Electrical Steering Gear, F. L. Dyer & L. H. Dyer, Washington, D. C, 550,018. Filed Oct. 4, 1894.
The method of controlling electric motors, which consists in constantly completing an electric circuit in which the motor to be controlled is placed, and by means of the controlled motor constantly completing a circuit in which is placed a second motor which tends to constantly break the circuit of the controlled motor.

Game Apparatus, A. W. Fall, Hoboken, N. J., 550,070. Filed Mch. 18, 1895.
Permanent magnets are used as the force for producing the motion.

Railways and Appliances:—

Underground Trolley System, C. E. Hubbs, Streator, Ill., 549,990. Filed May 23, 1895.
Details of construction. The trolley wheel makes contact from below.

Underground Conduit, J. F. Cummings, Detroit, Mich., 549,995. Filed Mch. 4, 1895.
Embodies a duct connecting into junction-boxes or manholes, with a non-hardening fluid insulation around the conductor, so arranged that from any desired section of duct the liquid can be withdrawn and the conductor removed or repaired without disturbing the other sections.

Closed Conduit Electric Railway, H. A. F. Petersen, Milwaukee, Wis., 550,057. Filed Oct. 29, 1894.
Details of construction.

Trolley, F. J. Pribyl, Hazleton, Pa., 550,059. Filed March 9, 1895.
Means whereby when the trolley accidentally slips from the conductor or wire the same will be automatically and almost immediately returned to the same.

Underground Trolley System, C. J. Hamilton, Philadelphia, Pa., 550,102. Filed April 26, 1895.
The free wire is sustained below the surface of the ground, provision being made for automatically opening and closing doors as the trolley-car progresses, which prevents tampering with the feed-wire.

Electric Appliance for Railways, H. A. F. Petersen, Milwaukee, Wis., 550,182. Filed March 19, 1894.
Improvements in electrically actuated apparatus for adjusting the movable switch rails or tongues of electric railways.

Electric Car or Locomotive, R. Eickemeyer, Yonkers, N. Y., 550,220. Filed April 8, 1891.
Relates to motor frames, etc., for motors direct connected to wheel by connecting rods.

Switches, Cut-Outs, etc.:—

Rheostat for use in Electric Motor Circuits, R. Eickemeyer, deceased, Yonkers, N. Y., 550,044. Filed Jan. 14, 1893.
Provides for a gradual automatic cutting-out of a desirable proportion of the outside resistance (after the motor circuit is closed) independently of any control by the electric current and then to leave the automatic cutting out of the remainder of the resistance subject to electric control, and further provides that the entire resistance shall be thrown in by means which are controllably accessible on the elevator-car, as when stopping the motor.

Fuse Box or Cut-Out, A. C. Carey, Lake Pleasant, Mass., 550,096. Filed Apl. 18, 1895.
A binding post having a longitudinal slot and a nut, combined with a block fitted to the slot in such a post and held therein by the nut, the said block being slitted and bored longitudinally, and adapted to receive the bared end of a wire.

Telephones:—

Toll Collecting Telephone Apparatus, G. K. Thompson, Malden, Mass., 550,204. Filed Aug 24, 1895.
The combination with a coin chute, a lever, and means for rotating the lever through an arc proportional to the size of the coin.

PATENT NOTES.

COMPOUND RAILWAY GENERATORS IN PARALLEL.

The Acting Commissioner of Patents, F. S. T. Fisher, has rendered a decision in the appeal of Mr. Walter H. Knight from the decision of the Examiners-in-Chief, awarding priority of invention to Mr. B. G. Lamme, for the method of connecting compound wound railway generators now largely in use. The Commissioner sustains the decision of the Examiners-in-Chief awarding priority to Lamme. Claims 5 and 6 of Lamme read as follows:

5. The method herein set out of adjusting compound wound dynamo electric machines connected in parallel, which consists in maintaining a resistance constant in amount but variable in distribution in circuit with the series coil between the omnibus wire and the equalizing connection, while varying the current passing through the series coil; thus permitting the independent adjustment of one of the machines in parallel while allowing the others to run undisturbed.

6. The method of individually regulating the compounding effect of the series coils of a number of dynamos feeding the same work circuit in parallel, and connected as described, which consists in separately varying the currents flowing through said series coils without changing the resistance between the omnibus wire and the equalizing connection.

LEGAL NOTES.

DECISION OF THE UNITED STATES SUPREME COURT IN THE UNION PACIFIC CASE.—NO EXCLUSIVE WESTERN UNION CONTRACT.

The United States Supreme Court, in an opinion by Judge Harlan, on Nov. 18, held in effect that the Union Pacific Railroad Company had no right to make a lease practically giving the Western Union Telegraph Company an exclusive right to maintain telegraph lines along the road of the railroad company. The case came up from Nebraska, and the court by its decision reverses the judgment of the United States Circuit Court of Appeals, and affirms the judgment of the Circuit Court for the Nebraska District.

The decision rendered holds that the United States has a right to maintain a bill in equity to compel the Union Pacific to maintain its own lines of telegraph along its route, and the obligation imposed on the railroad company to do this was as strong as its obligation to maintain the railroad tracks.

In the case of the United States against the same two corporations to recover moneys paid for government messages to the Western Union since 1881 sent over the lines along the Union Pacific right of way the court affirmed the judgment below in favor of the corporations. The court said if it could be shown which messages were sent over the Union Pacific lines on the north of the railroad track and which over the Western Union lines on the south, it would hold that reimbursement should be made for the former messages, but since the evidence was to the effect that it was impossible to distinguish them, it would decide against the United States claims.

PERSONAL.

MR. H. N. RAMSEY has resigned the superintendency of the Merrill Railway and Lighting Plant, and has accepted the position of electrician to the State Hospital at Middletown, N. Y.

CLEVELAND, O.—Prof. C. H. Benjamin is to talk before the Cleveland Electric Club on Dec. 4 on "Fly Wheels and Why They Burst."

MR. CHARLES PHILLIPS, Assistant-Engineer of the National Telephone Company, of England, is now on a short professional visit to this country. Mr. Phillips has spent some time in inspecting the plant and methods of the Metropolitan Telephone Company in this city and expects to visit Buffalo and Philadelphia before returning home. His early training, as with many English electrical engineers, was gained in submarine cable work, but he has been connected with telephony since the establishment of the first exchanges in England.

MARRIED.

COHO-BROSIUS.

The marriage took place on Nov. 21, at Lancaster, Pa., of Mr. Herbert Benjamin Coho, of H. B. Coho & Co., New York city, to Miss Gertrude Coates Brosius, daughter of Mr. and Mrs. Marriott Brosius. A large number of electrical friends extend their warm congratulations to the happy pair.

OBITUARY.

CAPT. J. P. FREEMAN.

Capt. James P. Freeman, Inspector of Electric Lighting for the District of Columbia, died at his residence, in Washington, on Nov. 16, after an illness of several weeks. He was a native of St. Louis.

REPORTS OF COMPANIES.

THE LOUISIANA ELECTRIC LIGHT COMPANY DECLARED INSOLVENT.

The litigation having for its object the placing of the Louisiana Electric Light Company in the hands of a receiver, before the United States circuit court for some time, resulted last week in a decree appointing George Q. Whitney and A. S. Badger as receivers. In the decree, the court said the company is insolvent, that its affairs have been badly managed by the present directors, etc. The Louisiana Electric Light Company controls the Edison company in the city. It has the contract for lighting the streets and practically has a monopoly of the electric light and power business in New Orleans.

WHAT A "WESTERN UNION DIRECTOR" SAYS.

The Boston *News-Bureau* is responsible for the following:—which in turn it attributes to Kiernan's News Agency. "A director of the Western Union Telegraph Co. says: '"The Bell Telephone contract expires next spring, and it will not be renewed. The directors would be glad to officially cancel the contract now. The Bell Co. has broken every clause of its contract with us repeatedly and they owe us a vast sum of money. As to the Bell Telephone Co. going into the telegraph business, I can say it has practically been doing it for three years. But there are two sides to that question—there is nothing to prevent us from going into the telephone business and this we will do. We do not intend to have any connection with the Bell Co. after the expiration of the contract."'

INTERNATIONAL TELEPHONE CONSTRUCTION CO.

The International Telephone Construction Company, whose office is in the Rialto Building, Chicago, has failed. The company made an assignment in the County Court to Lynden A. Seymour, who took charge of the assets of the company and will wind up its business.

INCREASING THE NIAGARA POWER HOUSE CAPACITY.

PROPOSALS have been called for on the enlargement of the wheelpit of the Niagara Falls Power Company to provide for three additional dynamos and turbines to furnish additional power for local use. The Acetylene Gas Company has closed a contract with the power company for 10,000 horse power. Work on the Canadian power plant is also to be pushed.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE NATIONAL ELECTRICAL EXPOSITION COMPANY.

The National Electrical Exposition Company of New York City has been formed to hold exhibitions of all productions of electrical and kindred industries. Capital $10,000. Directors—Harrison J. Smith, Marcus Nathan, Robert B. Corey, Stephen A. Douglas, William F. Weise, William A. Stadelman, C. O. Baker, Jr., John A. Seely, and George F. Porter of New York City. This is the Company which proposes to co-operate with the National Electric Light Association next Spring in holding a first class exhibition in this city, of modern electrical appliances and inventions, particularly those in the field of light, heat and power.

THE CARPENTER ENAMEL RHEOSTAT CO.'S PROSPERITY.

The Carpenter Enamel Rheostat Co. declared upon November 18th its 18th dividend since September, 1894. This Company by good business methods, low prices, and reliable apparatus, has taken a unique position in the rheostat field. The Leonard electric soldering iron, the Leonard combination curling iron and heater and the Leonard automatic motor starter recently placed upon the market by the Carpenter Company, are making it hustle to keep up with its orders.

"KOKOMO" TELEPHONE PLANTS.

The American Electric Telephone Co., of Kokomo, Ind., reports that it has recently sold the following telephone plants: St. Joseph, Mo., 1000 telephones; Cairo, Ill., 300; Madison, Ind., 200; Elkhart, Ind., 200; Middletown, N. Y., 200; Falls City, Neb., 100; Butler, Pa., 150; Holidaysburg, Pa., 75. It is also enjoying a brisk inquiry for its Hunnings transmitters, etc., and is well pleased with the results of its exhibit at the Atlanta Exposition.

A LAMP THAT THINKS LIFE WORTH LIVING.

The Electric Appliance Company is in receipt of the following testimonial letter from the Monroe Electric Light & Power Company, Monroe, Michigan:

"We have one Packard 16 candle-power 104-volt lamp still burning every night on an average of over twelve hours a night ever since Nov. 14th, 1891. This is the only one left of those lamps of the first lot that we bought of you. It has now burned over 17,500 hours, and it still burns brightly and nice and the globe is only blackened up a very little. Can anybody on your books beat that for a long burning lamp? There is no telling how long it will still burn."

(Signed) G. R. HURD, *President.*

THE COPE CONDUIT CREEPER IN MILWAUKEE.

The conduit measuring worm or creeping machine, says a Milwaukee paper, is the invention of T. J. Cope, of Philadelphia, who is now in Milwaukee superintending its work in the conduits of the Pabst Electric Lighting Company. This remarkable machine practically walks through a conduit 450 or 500 feet long in from two to five minutes, carrying with it the wire intended to be put through. The machine is 5 feet in length and can be bent to go around any curve or twist in a conduit with perfect ease. It has greatly simplified the work of constructing underground electrical systems.

ATLANTA EXPOSITION MEDAL AWARDS.

Some of the awards at the Atlanta Exposition have been announced with creditable promptitude. The list of highest gold medals includes the American Bell Telephone Co., the Westinghouse Electric & Mfg. Co., two; the General Electric Co., two; the H. W. Johns Mfg. Co.; the H. R. Worthington Pump Co.; Straight Line Engine Co.; Buckeye Engine Co.; Lane & Bodley Engine Co.; Niles Tool Works.

PHILADELPHIA NOTES.

THE ACETYLENE LIGHT CO., of Philadelphia, has voted to increase the capital stock from $1,000,000 to $2,000,000. Of the new issue $750,000 will pay for patent rights and the balance goes into the treasury. All the new stock has been taken by the stockholders.

MR. THOMAS MARTINDALE, the well known local municipal reformer, has evolved the scheme of city ownership of the street cars, a three cent fare, and a seat for every rider. It is a familiar fact that Philadelphia is so free from debt that it can buy the moon if it wants to.

MR. MORRIS MEAD, superintendent of the bureau of electricity of the city of Pittsburgh has now put in force a new department of wire inspection which is to examine and approve all the wiring done, and which issues permits for such work. The object is to put a check on the dangerous work that has been done by incompetent, untrained men.

THE AMERICAN BOILER STOKER.

EXPERIENCE has shown that with all the refinements of modern boiler construction the benefits expected may be set at naught by poor work on the part of the fireman, and tests on this point have shown vast differences in boiler economy with different men feeding the furnaces. To make the boiler independent of this variable factor in the cost of steam generation mechanical stokers have been designed. Among the more recent of these is the "American" stoker, manufactured by the American Stoker Co., of Dayton, Ohio.

This stoker consists of a hopper, capable of holding one hundred and fifty pounds of coal, placed between the ash-pit doors, occupying but twenty-four inches of space in front of the boiler and allowing the doors free swing. Directly beneath the hopper is an incased gear, driving a "worm," which enters the furnace by an opening but ten inches in diameter in the boiler front. Within the front is a V-shaped coal-bed, three feet wide at the top, two feet deep and extending the length of the grate bars. Along the top of the coal-bed, on each side, is placed a row of heavy iron blocks, called "tuyere blocks," through which the air is discharged into the coal. These tuyere blocks are about the size of a brick, weigh twelve pounds each and are very easily replaced.

The coal fed into the hopper is conveyed into the coal retort by a steel conveyor, and when there is evenly distributed and raised in a body to the level of the "tuyeres."

As the coal slowly approaches the fire above, it becomes hot, the volatile gases are released and mixing with a supply of air from the tuyeres are exploded into a flame. This air is supplied proportionately to the amount of coal fed, and at a mild pressure.

The gases having been drawn from the coal, the coke remains, and this being pushed up by continuous feeding from beneath, spreads over the entire grate surface, thoroughly charged by the air and intensely hot. It can be readily understood how impossible it is for the smoke-producing gases ever to pass through this coke bed and not be consumed. The combustion of the fuel is complete. The non-combustible in the coal is removed in the shape of small vitrified clinkers which are pushed to the side grates by the continuous feeding of the coal from beneath, and can be removed in two minutes. The action of the coal under continuous feeding is very beneficial. The coal is always in action—breathing as it were—and the air penetrates it thoroughly. Large clinkers can not be formed, as the movement in the coal prevents their formation.

The rate of feeding the coal is regulated by the lever seen in front of the coal hopper. Six different speeds are obtainable, and coal may be fed at a rate of from 25 to 1,500 pounds per hour. The power to actuate the stoker and drive a small blower is derived from a small upright engine, which with the blower forms a part of each equipment. The ability to force a boiler is unlimited, as there is no dependence on natural draft.

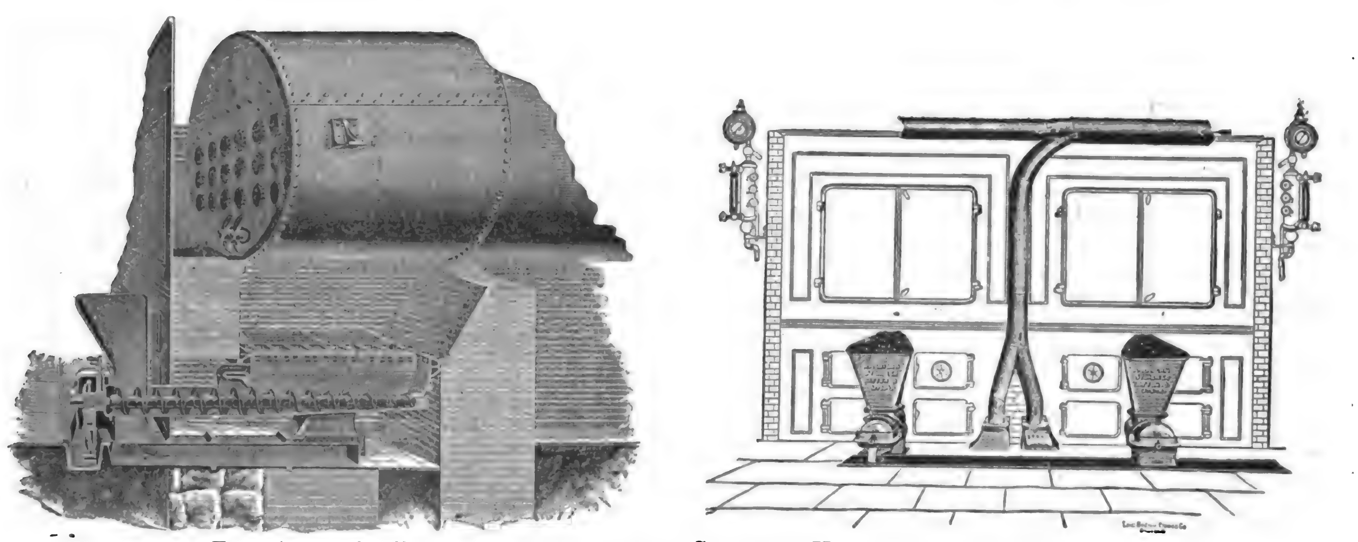
In applying the stoker there is no need of taking down the boiler front or interior; under ordinary circumstances, any boiler can be equipped and put in running order within twelve hours. None of the mechanical parts of the stoker are subjected to heat, thus obviating the difficulties caused by expansion and contraction. The tuyere blocks are the only part coming in contact with the fires and these are constantly filling with air, and experience has proven that they will not burn out in nine months' severe duty.

The stoker has been in operation under various conditions over a year and the results have been most satisfactory. Quite a number of them have been placed in Toledo, Detroit, Cleveland and Cincinnati, and the company has now completed its arrangements by which it will have a capacity of ten stokers per day and will enter the entire field. Very interesting experiments have been made, looking to the adaptation of the stoker in puddling and heating furnaces, and tests exist, showing that by use of the stoker, the output of iron can be increased from 30 to 40 per cent., the fuel being bituminous slack coal.

The stoker is essentially a gas producer and a gas burner. By the use of the cheaper grades of coal, a large saving is made in the difference in price of coal, and the regularity of the heat and the draft enable the operator to steam a boiler far beyond its rated capacity. In an installation of ten boilers, 60″ x 14′, in a large steel works in Detroit, the stokers are developing 129 H. P. under each boiler.

The absence of soot in the boiler flues is also another marked feature. The fact that the poorer grades of coal can be burned without smoke and practically no ash is cited as proof of the fact that in the conversion of the cheaper coals into gas, all of the volatile elements in the coal are removed and consumed.

As there can be no loss by dropping through grates, coupled with the fact that the flue temperatures are very low and the evaporation results very high, is evidence that the stoker is furnishing as complete combustion as is possible.



FIGS. 1. AND 2.—THE "AMERICAN" STOKER.—SECTIONAL VIEW AND FRONT OF BOILER.

The stoker is especially adapted for use on ship board, and experiments are now being made by a prominent railroad company, looking to its use on locomotives. The fact that hand firing can be resorted to at any time, is a very valuable feature.

THE MAMMOTH METROPOLITAN CATALOGUE.

The Metropolitan Electric Co. of Chicago have just issued a catalogue which repeats with heavy emphasis the opinion of that bustling town, that bigness is a notable virtue in itself. Of course, if the book were merely big, it would have little more value than so much lead; but size is only one of its claims to attention. It is 8 inches wide and 11 inches long, and 1¼ inches thick, and tips up all the scales that most offices are provided with. The covers are massive, and flaunt the national colors, with the name of the Company on the middle white panel; while the title is also repeated in large, handsome lettering on the linen back. There are 750 pages in the volume, and about 1500 separate headings in the index. The cuts are legion. Hardly a page is without one, and on many pages they bristle five and six deep; in one instance, there are fourteen. What makes the cuts more evident, perhaps, is the ingenious way in which they are all strung along the outer edge of the page; so that you are tempted to open the book, and when you do that you naturally note also the moderate list price; the effect being that of a well arranged show window which wins customers and makes sales.

As to the contents of this burly book, it must suffice to say that it is a compendium of practical applications in electricity, for no branch of the art is neglected or overlooked. The store that requires such a catalogue as this must necessarily be a universal emporium. There are in addition to the trade supplies and specialties, some admirable tables, rules, data, &c.

AUSTIN, TEX.—Mr. F. E. Scoville, the electrical engineer of the Austin, Tex., municipal plant, informs us that there are now over 8,000 16 C. P. lights connected. The plant was started May 7.

DOES THE HATCH STORAGE BATTERY INFRINGE?

THE following letter has been addressed to Mr. W. W. Gibbs, president of the Electric Storage Battery Co., by Mr. Jacob E. Ridgeway, president of the Hatch Storage Battery Co., under date of Nov. 20:—

Your letter of Nov. 19, 1895, addressed to me as president of the Hatch Storage Battery Company, has been received and contents noted. In reply thereto I beg leave to say that I and my associates caused to be made a thorough examination, both as to the merits and title of the Hatch Battery, before we became identified with the enterprise. We were advised by experts of the highest competency that this battery is a complete departure from the type of Storage Batteries such as are manufactured by your Company, and is a distinct step in advance in the art. They also advise us that they are equally as efficient and are lighter and cheaper to construct than other batteries and, therefore, meet public requirement in this line of electrical work. You speak of being informed by your electrical experts and counsel that our battery "infringes on important patents owned by your Company," and we are likewise informed by our experts and counsel that our patents cover a distinct field and do not in any way infringe on any patents owned or controlled by your Company. We are fully prepared to meet that issue in any form or manner in which your Company may desire to make it.

ELECTRIC LAUNCHES AT THE ATLANTA EXPOSITION.

Mr. J. C. Chamberlain, general manager of the Electric Launch Co., Morris Heights, this city, has just returned from Atlanta, where he has been busily engaged during the past three weeks in reorganizing the launch service at the Exposition.

The original concession was sold to a corporation known as the Electric Transportation Co. who leased the launches from the Electric Launch Co. but failing in its obligations the concession has been transferred by the Exposition Company to the Launch Co. itself, which is now operating the fleet of boats with much success.

These launches are recognized as one of the features of the Exposition as they were at the World's Fair and are proving very popular with visitors of all classes.

ADVERTISERS' HINTS.

THE GENERAL ELECTRIC CO. advertise an arc lamp requiring the minimum of energy to produce the maximum of light.

THE FORT WAYNE ELECTRIC CORPORATION call attention to the "Wood" system of alternating current machinery and apparatus for light and power.

THE STANDARD AIR-BRAKE CO. report that they are pushing ahead with the manufacture of their brakes to keep up with the increasing orders.

THE STANDARD PAINT CO. warn people against false economy by using inferior substitutes. They continue to find a ready market for the P. & B. products.

THE ELECTRIC APPLIANCE CO. say "Coin is not in it with our school of practical and applied electricity" and they further show that a manufacturer cannot sell a lamp below its cost and make money. This seems reasonable.

ON BROOKLYN BRIDGE.

Both the General Electric and the Westinghouse Companies have received permission to run an electric train on the Bridge; and if such trains are satisfactory, it is recommended that a contract for the full equipment of the Bridge be entered into.

NEW YORK NOTES.

MESSRS. H. B. COHO & CO., of 203 Broadway, New York, have installed four 100 K. W. Eddy type "G" generators in Hammerstein's Olympia, 44th Street and Broadway, New York.

THE PEOPLE'S ELECTRIC LIGHT AND POWER CO. of Oswego, N. Y., have contracted with the Kingsford Foundry & Machine Co. for one of the latter's Eclipse boilers of 150 H. P. capacity.

BLAKE & WILLIAMS have received a contract to furnish an electric light plant for the New York terminal of the Brooklyn Bridge, at the price of $10,249.

THE CHESLEY ELECTRIC CO., 601-605 Newark St., Hoboken, N. J., have been very busy on repair work and have recently put in some heavy machine tools. They have also opened an office in the Havemeyer Bldg., New York city, in charge of Mr. W. J. Johnson. This company report a number of sales of second-hand machines of which they make a specialty.

THE STANDARD AIR BRAKE CO. of 35 Wall street, has for sale 62 of the old electric open air cars of the World's Fair Intramural Railway, on which they carried some 8,000,000 passengers. Here is certainly a good chance for an enterprising street or elevated road. Three men handle a train of four cars carrying from 850 to 400 passengers.

THE JOHNSON-LUNDELL ELECTRIC CO., has been formed to manufacture dynamos and electrical apparatus to produce light in New York City. Capital $500,000; and directors: Edward H. Johnson, Robert Lundell, Frank S. Hastings, Harry E. Robinson, Martin J. Quinn and Edward Beers, of New York City. The Johnson-Lundell closed conduit trolley system is to be tried on a street car line at the foot of West Thirty-fourth street.

THE DYNAMO ELECTRICAL MAINTENANCE CO., of New York and Boston, have appointed Mr. C. A. Bowditch as general manager, who is at present in New York looking after the interests of the company. Mr. Bowditch reports that the business of the company is good, and that he hopes soon to have a large clientage among the users of electric power in the city. The business of the company is to keep electric apparatus in repair, making contracts to do so by the year.

WESTERN NOTES.

THE SKEEN ELECTRIC SWITCH & SIGNAL CO. of St. Louis has been incorporated with a capital stock of $5,000, one-half of which has been paid in.

THE DETROIT RAILWAY has issued $1,800,000 of bonds on its franchise and tracks, through the Cleveland, O., Trust Co. The company is stocked for $1,000,000.

INDIANAPOLIS, IND.—It is proposed to establish the office of city electrical inspector, and the local electrical workers have petitioned to that end.

M. S. CARTER & CO., builders, of St. Louis, have been awarded the contract for a building for the Bell Telephone Co. at St. Joseph, Mo. It will be three stories high, brick front and of an ornamental character.

MR. THOS. G. GRIER, of Grier Bros., Western Managers of the Bryant Electric Co. of Bridgeport, Conn., has quite recovered from the effects of his recent dangerous illness, and has settled down to business again.

THE PACKARD ELECTRIC CO., Warren, O., are again compelled to increase their factory area by reason of increased business. A portion of the factory is devoted to machine shop purposes, and the latter shop will be removed and the entire building be used for the manufacture of incandescent lamps. Another building will be used for the machine shop.

THE ELECTRIC APPLIANCE COMPANY'S monthly publication known as the *Electrical Trade* is being well received by the electrical people generally, it says, and should prove a good advertising medium for the concern. Each issue contains several pages of interesting electrical reading matter. The cover carries a moonlight schedule.

THE UPTON ARC LAMP.—The Electric Appliance Company is ready with a very complete catalogue of the Upton arc lamp, showing a large line of plain and fancy lamps for regular series arc, direct current constant potential, and alternating constant potential circuit. They claim to have what has long been looked for in the alternating arc lamp line, and that is a noiseless lamp.

MR. E. W. HAMMER, of the Cutler-Hammer Mfg. Co. Chicago, has just returned from a combined business and pleasure trip to the East in which he visited New York, Boston, Philadelphia, and several other places. Mr. Hammer is greatly pleased with the result of his visits, as he not only had a very enjoyable time, but secured some nice orders for the concern with which he is connected.

THE PARTRIDGE CARBON CO., Sandusky, O., have been doing considerable experimenting of late with their "Self Lubricating Motor Brush," and trying all kinds of tests, and now they have one of the finest brushes that ever was put on a commutator. Any street railway company that has had trouble with the brushes sparking, irregularity in running, too soft, or gumming commutators should give the Partridge brush a trial. Motor and generator brushes are made for all kinds of machines. The concern state that they make but one grade of brushes—*the best.*

NEW ENGLAND NOTES.

MR. CHARLES B. RAULE has moved from Milford, Mass., to New London, Conn., in order to engage in the electrical business in the latter city.

MR. HENRY SACHS, former manager of the Beacon Vacuum Pump & Electrical Co, has been appointed general manager of the Cole and Gerald Manufacturing Co., makers of the "Greyhound" bicycle, with office and salesroom at 145 Massachusetts avenue, Boston, factory at Brookfield, Mass. Mr. Sachs would like to open correspondence with his old friends in the electrical supply business with a view to establishing agencies for the sale of the "Greyhound" which is to be the leading wheel of the future.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.
Vol. XX. DECEMBER 4, 1895. No. 396.

POWER TRANSMISSION DEPARTMENT.

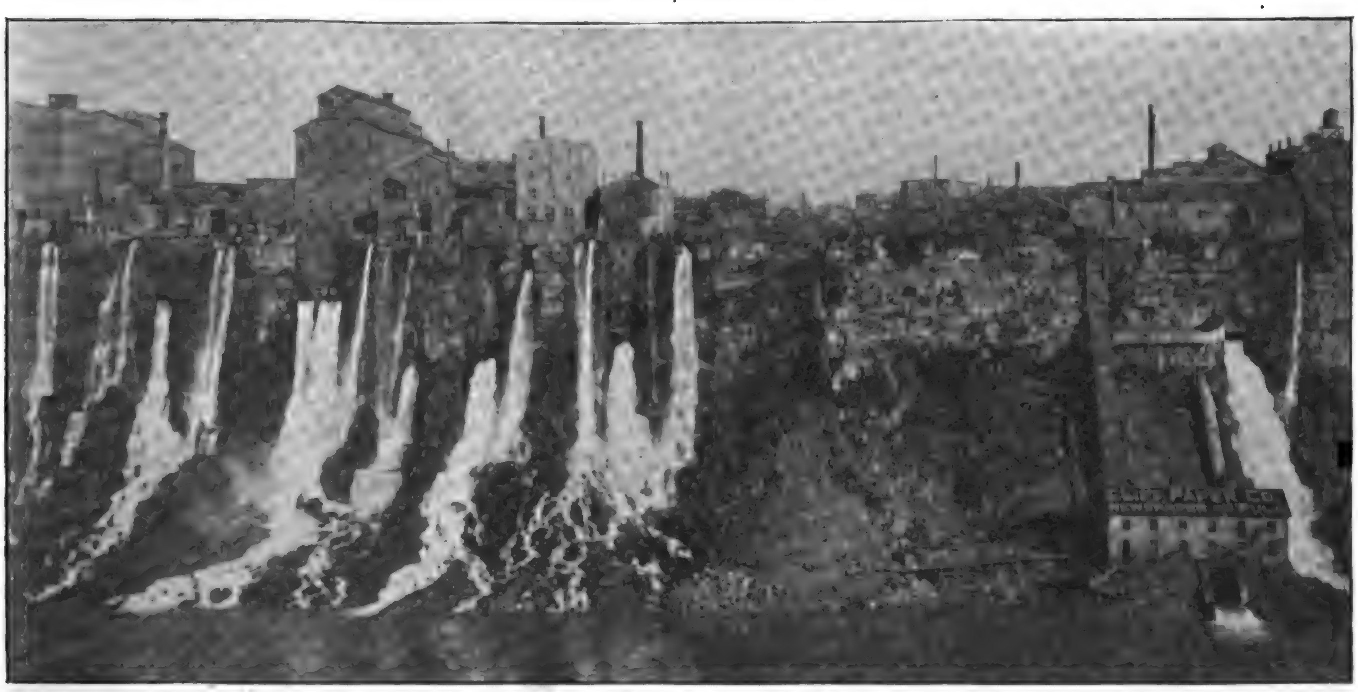
THE NIAGARA FALLS HYDRAULIC POWER AND MANUFACTURING CO.'S NEW WORK.

BY ORRIN E. DUNLAP.

THE Niagara Falls Hydraulic Power and Manufacturing Company is now engaged in work which, when finished, will very materially increase the electric power supply of Niagara Falls, already quite properly dubbed the "Power City of the World." This company is controlled by Jacob Schoellkoff of Buffalo and Arthur Schoellkoff of Niagara Falls. They own a surface canal which diverts a portion of the water of the upper Niagara river from its natural channel to a basin located on the high bank of the lower river a short distance below the State Reservation. This canal is the oldest power project at Niagara, and since the Messrs. Schoellkoff obtained possession of it some years ago they have developed its facilities in a marked degree, especially of late, when the waterway has been widened and deepened at an outlay of many thousands of dollars. This expense was undergone for the purpose of securing more water for power and preparatory to the project which is now commanding their attention.

Their plan is to build a large stone power house 60 feet long by 100 feet wide in the gorge at the edge of the water in the lower river. This structure will be constructed so that it can be lengthened as the demand for power makes it necessary. The site for the building has been cleared and the foundation walls started. In order to get the required foundation it was necessary to clear away the great mass of disintegrated rock and huge boulders which represented the accumulation of droppings from the cliff for centuries, and this was no small task. In some places this mass was 80 feet deep, and to effect its removal a Giant or Monitor, the machine so extensively used in hydraulic gold mining in the West, was brought into use, it being the first used in this locality, if not in the East. When the debris was cleared away a stratum of Medina sandstone was found, and on this the building in which Niagara's latest quota of additional electric energy is to be generated will stand.

In the new station, on the first floor, will be placed four turbine wheels of the horizontal type. They will furnish about 7,000 H. P., and will work under a head of 210 feet, which is said to be the highest head under which water has ever been used for power in the quantity proposed in this plant. These turbines will be mounted on horizontal shafts of the double discharge pattern, and fitted with runners 74 inches in diameter, made of extra quality bronze metal and equipped with balanced gates. They will be so



THE NIAGARA FALLS HYDRAULIC POWER & MANUFACTURING CO.'S WORK.—SITE OF THE PROPOSED NEW POWER HOUSE ADJOINING CLIFF PAPER CO.'S MILL.

THE NIAGARA FALLS HYDRAULIC POWER & MANUFACTURING CO.'S WORK.—THE HYDRAULIC CANAL BASIN AND MANUFACTURING DISTRICT.

designed that the wheel runners will be absolutely balanced by the equal discharge of water on each side, thus doing away with all end thrusts on the shafts. Cases eleven feet in diameter and made of the best double riveted, heavy plate steel will surround the turbines. On the bottoms of these cases the feeder pipe connections will be made, being riveted directly to the five-foot hydraulic cylinder valves. All these valves will be connected to the main feeder pipe, which will be ten feet in diameter, and occupy space between the foundation walls and under the turbines. The draft tubes from the turbines will pass down each side of the main feeder pipe, connecting with the tail water, which will be set at a distance of 27 feet from the centre of the turbine shaft. The shafts will be made of the best quality hammered wrought iron, and carried in adjustable ring oiling bearings, mounted on heavy cast iron bridge trees.

The present canal of this company diverts a small portion of the water of the upper Niagara from its natural channel to a hydraulic basin located about 300 feet back from the edge of the high bank of the lower river. From this basin, through a series of flumes, several large mills now receive an excellent power supply, and from it the water supply of the new power house will be taken by means of an open canal, 30 feet wide by 22 feet deep, which will lead to a forebay now being built near the edge of the high bank. From this forebay, penstocks, eight feet in diameter, built of flange steel, will conduct the water down over the high bank to the site of the power house at the water's edge. The pressure exerted by water under this head is so enormous that great care is being taken in designing every detail of the penstocks and wheels. From the forebay the penstocks will extend vertically about 135 feet to the top of the debris slope, thence down the slope to the side of the station next to the bank, making the total length of the eight-foot pipe about 240 feet. A pipe 10 feet in diameter will run into the building, suspended horizontally over the tail race. The steel in the pipe will be fifteen-sixteenths of an inch in thickness. All horizontal joints will be butt-strapped, held with three rows of rivets on each side, and the cross seams all double riveted. It is figured that the total pressure on the end of this pipe will exceed one million pounds. From the horizontal portion of the penstock above referred to, the water will be taken up through 60-inch valves upon the outer wheels, which will be supported by iron beams stiffened by braces into the sides of the tail race.

The turbines are being built by James Leffel & Co., of Springfield, O., under general plans and specifications made by W. C. Johnson, the chief engineer of the Niagara Falls Hydraulic Power & Manufacturing Company. Three of these turbines are guaranteed to generate 1,700 H. P. under a head of 205 feet, which is the minimum head estimated as obtainable, and run at a speed of 250 revolutions a minute. As the ordinary head will be from 210 to 215 feet it is expected that the power of these wheels will be from 1,800 to 2,000 H. P. each. Three of the turbines will be connected with six generators, two to each wheel, and these will supply electric power at a low voltage to the Pittsburg Reduction Company for use in their new aluminum smelting plant to be built on the top of the high bank. The fourth turbine will be attached to two 560 kilowatt generators and run at a speed of 300 revolutions a minute, generating a 500-volt current for street railway and general power purposes.

This company has become an important factor in the Niagara power field. It now has two generators of 125 H. P. each running, from which about 200 H. P. is being delivered for power purposes It has also two 1,800 light alternators in operation, and they are fairly well loaded. This lighting apparatus is so constructed that it can be attached to either one of two wheels, and it has never failed to give its customers light since the plant was put in last June.

It is on the lands of the Niagara Falls Hydraulic Power & Manufacturing Company that the Cliff Paper Company's mill is located, and from their canal the necessary water for power purposes is taken. This paper company has a pulp mill at the water's edge in the gorge and its paper mill on the top of the high bluff, and thus it secures a double service from the water. This double use of water was quite an innovation, and has brought discredit upon the saying that "the mill will never grind with the water that is past." Now, however, this progressive company is about to take another step to practice economy, and they will adopt electricity to succeed steam to run its paper machines. When this proposed electrical plant is installed it will drive out three steam engines of over 200 H. P.

Preparatory to the adoption of the electric current this company will build a stone power house 20 by 30 feet in size, close to their pulp mill. The penstock leading to the pulp mill will be tapped and a portion of the water diverted to run a 250 H. P. turbine, to which will be attached two 125 H. P. generators. The head of water on this turbine will be 125 feet. Up in the paper mill two electric motors of 100 H. P. each will be attached to the paper machines, and besides, two motors of five H. P. each will furnish power for the small machinery about the mill.

Mr. A. C. Hastings is manager of this mill, and he states that his company were led to adopt electricity because they felt they could economize by its use. Their mill, he said, was particularly fortunate in the matter of power, the power they used not costing them $10 per H. P. per annum on the shaft. He recognized that electricity was revolutionizing many fields of manufacture and labor, and with the remarkable facilities for developing it cheaply at their command, he saw no reason why it should not be of great benefit to them. The plant will be perfected as rapidly as possible, and when completed the Cliff Paper Company will be the initial users of electricity for running paper machines.

DIRECT VS. ALTERNATING CURRENTS FOR LONG DISTANCE TRANSMISSION.—I.

BY

Wm. Baxter, Jr.

One of the most important problems that now confront the electrical engineer is the transmission of energy over long distances. The great majority of engineers of note, on both sides of the Atlantic, have for several years advocated the alternating current as the one that would give the most satisfactory solution of the problem. It does not always follow, however, that the plans that receive the strongest indorsement in the beginning are the best or the ones that survive in the end. Very often the original plans fail to meet the expectations of their admirers, and sink into oblivion through their manifest inferiority; then a retrospective survey of the field shows that their popularity was not due to intrinsic merit, but to causes entirely foreign thereto. Alternating currents for long distance transmission have not yet fallen into oblivion by any means, and it would not be prudent to say that they ever will, but a careful consideration of what has been done in that line, will show that the results are not any better than, if as good as, could be obtained by the direct current system.

There is a fascination about alternating current problems that, no doubt, has had a great deal to do with making the system a favorite with the foremost electricians. Most of these problems are so abstruse as to be beyond the comprehension of the average electrician; therefore those who are gifted with a mind able to grasp the subject, enjoy a certain amount of exclusiveness not obtainable in the simpler and more commonplace direct current field. This fact of itself would account in a great measure for the popularity of the alternating system; but it is not the only reason. There is another one to be found in the fact that the human mind is so constituted that it delights in overcoming difficulties; therefore it is quite possible for those who are engaged in developing the system to become so absorbed in their efforts to overcome the difficulties encountered in its application to commercial uses as to entirely overlook the practical side of the question.

The only field in which the alternating current has been used up to the present time with as much success as the direct current has been that of lighting. The use of a high electromotive force in the primary enables a station to cover a much greater territory than is possible with the direct current of low E. M. F. But I believe it can be demonstrated that a central station using a direct current of equally high electromotive force could obtain better and safer results, by dividing the territory into sections and locating in the centre of each one of these sections a rotary transformer operated by current received from the central station and delivering a current of 110 or 220 volts to the district surrounding it. In this arrangement, one large rotary transformer would take the place of a large number of small alternating transformers. If a frequency of 125, or thereabout, were used, the cost of mains for the alternating system would be more than for the direct. As to the transformers, it is more than probable that the large rotary machine would cost much less than the numerous small converters it would replace. As to safety, there could be no question. The direct current system would be absolutely safe, as the commercial circuits would not carry a dangerous electromotive force. A decided advantage of the direct current would be that it could be used to operate motors as well as lights.

It is not the purpose of this article to show that the direct current is more desirable than the alternating for local stations, but to demonstrate, if possible, that it is superior for the transmission of energy over long distances. This brief allusion to the relative merits of the two systems for local work is made to show that any advantages that the alternating current may appear to have are not due to the system, but to the fact that a higher electromotive force is used.

To determine the merits of the system for long distance work the best way is to analyze what has been done in that line. The most important work up to date has been the Niagara installation. According to the published descriptions of this plant, the main generators develop an electromotive force of 2250 volts. As this electromotive force is too low for the increased transmission of current over any considerable distance, step up transformers will be used to develop a current of higher E. M. F. to send over the line. At the receiving end a step down transformer will induce a tertiary current of whatever electromotive force the conditions may require. Inasmuch as in the present state of the art, alternating currents can only be used successfully for incandescent lighting, and with partial success for arc lighting, it follows that for all other purposes a direct current derived from a rotary transformer will be required.

In the Niagara plan of transmission as briefly outlined above, generators are used to develop a primary current, step-up transformers to develop a secondary current to send over the line and step-down transformers to develop a tertiary current for distribution at the end of the line. It is not at all likely that the step-down transformers would deliver a current of low enough electromotive force to operate lamps directly. This current would undoubtedly have an E. M. F. of one or two thousand volts, so that another transformation would be required to obtain a commercial current.

If the current transmitted is to be used for lighting, it will go through three transformations by stationary transformers, and there will be six sources of loss between the generator shaft and the lamps.

These losses will be as follows:—First, loss in generating primary current. Second, loss in generating secondary current for line by step-up transformer. Third, loss in transmission over the line. Fourth, loss in generating a tertiary current by step-down transformers. Fifth, loss in transmitting tertiary current over local lines to consumers. Sixth, loss in generating the final commercial current by small transformers located in the buildings or districts where the lights are used. If we assume all these losses to be as low as practicable, we will find that the energy utilized in the lamps will be about 61 per cent. of that applied to the generator shaft. This will be the result if the efficiency of the generator is ninety-four per cent.; that of the step-up, step-down and local transformers,

93 per cent., and the loss in transmission over the line, 10 per cent.

Now as a matter of fact these efficiencies are never obtained in practice, as an average performance, for the reason that the average output is seldom over sixty per cent. of the maximum. The line loss may be less than ten per cent. in actual practice, but the efficiency of the transformers will be between eighty and eighty-five per cent. Calling the efficiency of the generators 90, and that of the transformers 85 per cent., and the line loss 6 per cent., we would have less than 48 per cent. of the total energy delivered to the consumers.

If the efficiencies assumed in the foregoing are correct, then the energy recovered at the point of distribution by an alternating system such as the one installed at Niagara is less than fifty per cent. of that applied to the generator shaft, and this would be true for a transmission of ten or fifteen miles. An equally good result could not be obtained over a greater distance unless the line mains were made very large, so large, in fact, as to involve an expenditure for copper that would be almost prohibitive.

Such results are not very encouraging, even to the most ardent admirers of the alternating system.

But it may be asserted that the conclusions here arrived at are not correct and do not show as good results as can be obtained in practice. This may be true. The only way in which the actual efficiency of the system can be obtained will be by tests made when the plant is in full running order. Until that time we can only make calculations based on results already obtained with similar apparatus.

If we examine independently the several losses which make up the sum total of over fifty per cent. in the foregoing deductions, we will be better able to judge whether they are approximately correct or not.

Starting with the generator, we find that the efficiency is assumed to be 94 per cent. at full load, and 90 per cent. for the average all day work. These efficiencies certainly are not too low. Ninety-four per cent. at full load is a very fine result. Now as the average load is not over sixty per cent of the maximum, an average efficiency of 90 per cent. is also very high. It must be remembered that in an alternator nearly all the losses are constant, or practically so. The energy loss in field is constant; so are the hysteresis and the mechanical losses. The loss in the armature coils is variable, and to a certain extent the loss due to eddy currents is variable. As the principal losses are constant, the efficiency must necessarily drop considerably at a reduced output, and I believe that in practice it will be found very difficult to obtain more than 90 per cent. in a generator working at the average load.

As to the transformers, 85 per cent. may look very low, as tests of efficiency at full load have shown results as high as 96 per cent.; but tests subject to the conditions met with in actual practice have shown results lower than 70 per cent., while the average performance of transformers turned out by the best makers is under 83 per cent. It may be said that these results are obtained with small transformers, from twenty-five to one hundred lights, and that the step-up and step-down transformers, being of much greater capacity, would give a very much higher efficiency. While this may be true to a certain extent, the gain would not be anywhere near what the difference in size would lead one to expect. In transformers the hysteresis loss is going on all the time, whether there is much or little work being done by the secondary, and this constant loss will necessarily keep down the average efficiency even of the largest machines. In order, however, to remove all question of doubt as to the fairness of the assumptions herein made, the average efficiency of the step-up and step-down transformers may be taken at 90 per cent. On this basis the net energy delivered to the lamps would be less than 55 per cent. of that applied to the generator shaft.

We will now consider what could be done with a direct current system, and in making the comparison we will assume that the same electromotive force is used. The method of transmission would be as follows: The generators would deliver a current of high enough electromotive force to pass direct to the line without any intervening transformation. At the point of distribution this current would operate rotary transformers that would generate a current of the electromotive force required for distribution.

It will be seen at once that such a system would be more efficient than the alternating, because there would be only four sources of loss, namely: the generator, the line to point of distribution, the rotary transformer and the local distributing mains.

The average efficiency of the generators can be taken at 90 per cent., the same as that of the alternators. The line loss would be less with the same size conductors, but as the frequency in the alternating system here considered is only 25, the difference in the line efficiency would be less than one-half per cent. in favor of the direct current. We will, therefore, take the average line loss at six per cent., the same as for the alternating system. The rotary transformer could be made to give an efficiency of 85 per cent., but the present calculation will be based on 80 per cent. With these efficiencies the energy delivered to consumers would be about 64 per cent. of that applied to the generator shaft, against 54 per cent. for the alternating system.

From the foregoing it will be seen that, so far as efficiency is concerned, the direct current system is considerably ahead of the alternating; but it may be contended that there are difficulties in the way that would make it perhaps impossible to obtain in practice the results above given. This aspect of the subject will be considered later.

If we could do away with the step-up and step-down transformers, the efficiency of the alternating system would be largely increased. Under such conditions it could more than hold its own with the direct current; but whatever may be possible with respect to the step-up transformer, it certainly would not be prudent to drop the step-down transformer, and send the high potential primary direct to the premises of consumers. Discarding the step-up transformer would not render the system as efficient as the direct, because the loss in the step-down and small transformers would be greater than that in the rotary transformer of the direct current system.

It is hardly worth the trouble, however, to consider what the efficiency would be if the system of alternating current transmission were different from what it is. We must consider the subject as it stands. The most able electricians of the day have devoted themselves to the task of developing the system to the highest state of perfection. The fact that they have adopted step-up transformers, is proof that in their judgment they are required to give the best practical results. If this arrangement were used only at Niagara we might conclude that it was a case of poor engineering, but the same arrangement is used in other installations of very recent date. In The Electrical Engineer for Oct. 16, there appears an article descriptive of the Lowell, Mass., plant, in which the three-phase system is used. In this installation the primary current is of 360 volts, and by means of step-up transformers a secondary of 5,500 volts is obtained to send over the line. At the receiving end, this current is again transformed, and a third current of 360 volts is obtained, which operates a rotary transformer, from which a direct current of 500 volts is derived for the operation of a trolley line.

Taking into consideration what has been done and what is being done in the way of developing and perfecting the alternating system, I believe it is safe to assume that the arrangement involving the use of step-up transformers is the one that meets with most favor among engineers working in that field and is the line upon which future work will be conducted. This being the case, it appears to me that there is no room for doubt, as to the superiority of

the direct current, in point of efficiency of transmission; for, no matter how low the loss may be made in each transformation, as there are two more in the alternating than in the direct system, the total loss must be greater in the former.

THE LACHINE RAPIDS PROJECT.

The work at the Lachine Rapids is going rapidly forward. By the construction of a huge dam the north shore of the river for 800 feet has been driven 870 feet nearer to the middle of the river. This has been done to enable the work of deepening the river to the necessary 10 feet at low water to be carried out, that depth being necessary to afford the required head of water in the head-race. Nearly all this enclosure reclaimed from the river is now dry. The work of excavation is now going on. The engineering difficulties have been very hard to overcome, owing to the swiftness of the current and the turbulence of the water, but the temporary dam has been successfully completed. As soon as the excavations in the reclaimed area are finished, another dam, similar to the one now completed, will be built farther up the river, so that the whole length of the site of the head-race may be excavated to the full depth. Then the permanent dam will be built and the temporary one removed.

POWER SCHEMES FOR THE ERIE CANAL.

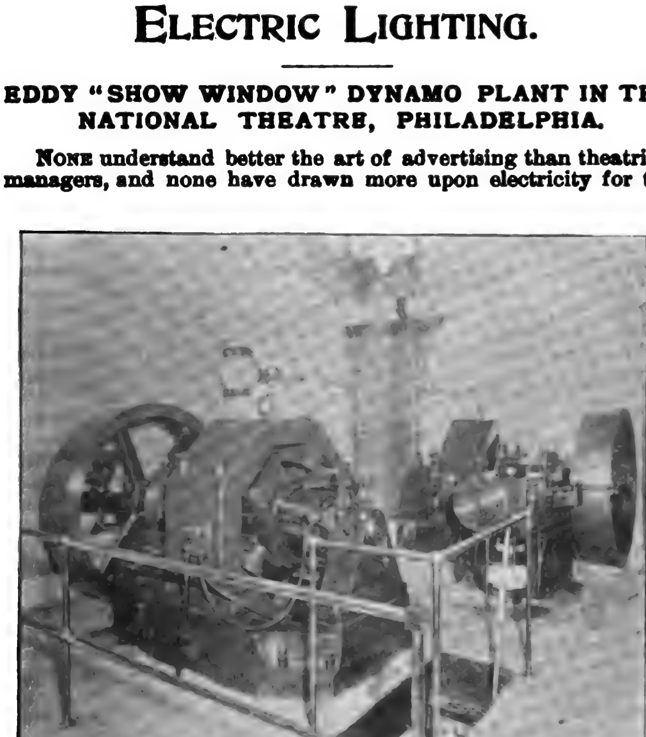
Dr. A. M. Vedder, of Lyons, N. Y., puts forward the following plan: "I can see no reason why the Erie Canal itself might not serve in part as a means for the economical distribution of the power derived. In Lockport there is a fall of about sixty-one feet in a distance of twenty five miles from Buffalo. Near Rochester there is a fall in the canal of about forty feet at a distance of about ninety miles from Buffalo. Still further eastward there is a succession of falls in the height of the Erie Canal, the waters of Lake Erie extending to the neighborhood of Cayuga Lake 160 miles east of Buffalo, with a descent of about eighty feet.

"If the waters of the Erie Canal were used for the generation of power for electric traction at the points most favorably situated throughout this section, it might prove to be economical. It certainly looks like a problem worth studying. The descent or fall between Buffalo and Cayuga Lake is greater than the fall of water over Niagara Falls, and the fall is a gradual one, extending over one hundred and sixty miles."

ELECTRIC LIGHTING.

EDDY "SHOW WINDOW" DYNAMO PLANT IN THE NATIONAL THEATRE, PHILADELPHIA.

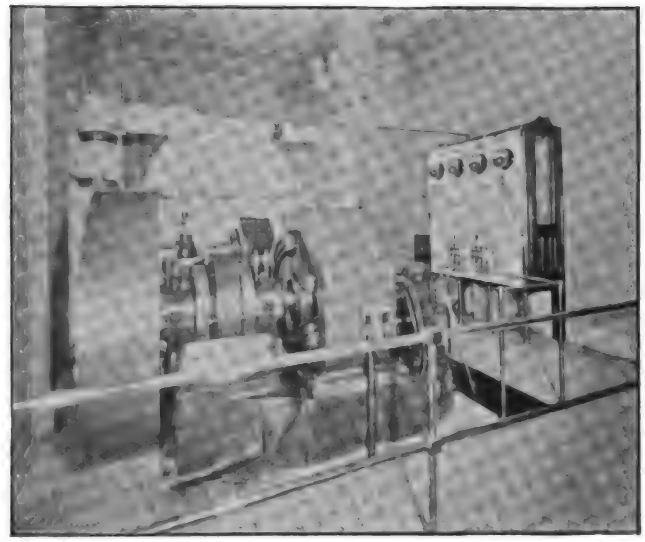
None understand better the art of advertising than theatrical managers, and none have drawn more upon electricity for the



Eddy Dynamo Plant in National Theatre, Philadelphia.

effects they desire to bring before the public eye. Heretofore theatrical managers while employing the electric light in profusion have invariably carefully concealed the source of the current, but it has remained for an enterprising and astute Philadelphia manager to make the electrical generating plant the objective point in attracting the attention of the public.

The plant in question is situated on the ground floor of the National Theatre, occupying the corner of 10th and Callowhill streets. The dynamo room floor is laid in beautiful mosaic, with frescoed walls and ceiling and a crystal chandelier gives the whole



Eddy Dynamo Plant in National Theatre Building, Philadelphia.
(The plant is in a store opening directly on the street level.)

plant the appearance of richness and elegance. The dynamos are two in number built by the Eddy Electric Manufacturing Co., of 50 kilowatt capacity each. They are of the company's new multipolar type with four steel poles bolted to a cast iron frame. The armature is of the iron clad type, ventilated, with copper bars laid in slots in the surface of the core. The end connection of these bars is so made that conductors of extreme potential difference have a maximum insulation and separation. The machines are direct connected to two Ames automatic engines with 18 x 12 cylinders. The marble switchboard, also shown in the illustration, is an additional ornament to the plant.

The entire installation was erected by Messrs. Walter C. McIntire & Co., the agents of the Eddy Co., in Philadelphia. Mr. J. F. McLaughlin was the engineer for the purchaser.

THE CAMBRIDGE, MASS., MUNICIPAL ELECTRIC LIGHT SCHEME.

If the resolution that it is expedient for the city to purchase the plant of the Cambridge Electric Light Company, as recommended by the joint special committee of the city council, should pass by the necessary two-thirds vote, the matter will then be submitted to popular vote at the city election, December 10. From the published report of the Electric Light Company for 1894-95, it would appear that the profits of their business were $24,989.83, of which amount $12,000 was paid in dividends to the stockholders. On a valuation of $475,200, which represents the assumed net cost of the plant, the profits would thus seem to have been about five per cent. As it is not claimed, we believe, by the advocates of this scheme that the business of supplying electric lighting can be conducted at any less cost under municipal than under private ownership, and as the experience in other cities shows a higher rate of cost under public management, we fail to see why it should be to the advantage of Cambridge to undertake this experiment which will involve a city debt of half a million dollars. It is very safe to say if our citizens expect to obtain electric lighting at lower rates under city ownership than they are now paying, that they will be mistaken. And the matter should be most carefully considered before any such rash and costly experiment is undertaken.—*Cambridge Tribune.*

(The necessary two-thirds vote, in favor of submitting to the people the question of a municipal plant, was not secured at the last meeting of the city council. This failure make it impossible for the city to buy such a plant within three years.)

WHAT KIND OF PORTLAND CEMENT IS THIS?

A considerable quantity of brick fell out of the west end of the Portland, Conn., Electric Light Company's building on the Portland side Thursday night. The building has been neglected for the past two years, and will go to pieces if it does not receive attention. Many of the windows have been broken out and other damage has been done to the property.—*Middletown, Conn., Press.*

INSULATION OF OVERHEAD AND UNDERGROUND CIRCUITS.[1]

BY CAPT. WM. BROPHY.

I HAVE chosen as a topic for discussion the "Insulation of Overhead and Underground Circuits Having a Difference of Potential of 2,000 Volts and Over." As you all know, the State Legislature passed a law applicable to the city of Boston, compelling the owners of all electric wires within a certain prescribed district to place them underground prior to the first day of January, 1900. This includes electric wires of every name and nature, with the single exception of the overhead trolley of the West End Street Railway Company. To the average man, the reason for this exception on the part of the body that sits under the "gilded dome" seems inexplicable. For my own part, I have never been able to fathom the motives that control the actions of our legislators at different times, and as a matter of fact I deem my life too short to attempt to do so. It is plain to me that if the electric light, power, telegraph, telephone, fire and police wires are dangerous enough to be removed from poles and other structures and placed under the surface of the street, the bare trolley should find a similar resting-place. If, as it is assumed, the aim and purpose of this law was to add to the safety of the public, by removing what is considered a serious menace thereto, it falls very far short of its purpose when it permits this class of wires to remain above the earth while all others are placed beneath it.

The enforcement of this law was placed in the hands of an officer known as the Commissioner of Wires; and the gentleman who was selected for this position has proved himself to be pre-eminently qualified to perform the difficult and delicate task imposed on him. The work has gone on rapidly, quietly, and successfully, without the least friction between the department over which he presides and the owners of the wires that have been doomed to summary removal from public gaze or touch.

To the task of supervising the burial of existing overhead wires is added that of prescribing the method of construction, insulation and proper maintenance of overhead wires outside the prescribed district from which they are to be banished, and also all wires in the interior of buildings within the limits of the city.

At the last session of the Legislature a law was passed compelling the insulation of all poles supporting electric light lamps or wires, and in the city of Boston the Commissioner of Wires is made the sole judge of the manner in which this shall be done. As every lamp pole in this city is constructed wholly of iron, and a goodly number of those in the public parks that support the wires are made of the same material, the task is not by any means an easy or inexpensive one. All the lamp poles are owned by the city, and some of those that are used for the support of wires.

I now come to the question of the insulation of the wires for high potential circuits.

My earliest recollection of arc light dynamos dates back to those of one light capacity, with a difference of potential of from 30 to 50 volts. No attempt was made at that time to run two or more lamps in series. After the lamp was improved, so as to make it possible to operate several of them in series, the capacity of the dynamos was gradually increased from 1 to 5, 10, 15, 25, 30, 50, 60 and 65 2000 candle power lamps at 50 volts and 10 amperes or 500 watts, increasing the difference of potential at the brushes or switchboard from 50 volts to 3250, this being exclusive of the energy required to overcome the resistance of the wire, connections, etc.

For some years no attempt was made to increase the capacity of arc light dynamos beyond 65 lights. Quite recently, however, 125-light dynamos have been constructed and put in operation. This means a difference of potential of 6,250 volts, independent of the resistance of the rest of the circuit.

I have thus far dealt with constant current dynamos and circuits wherein the difference of potential varies with the number of lamps in the circuit. But, as you all know, we have to deal with the primary circuits from alternating dynamos as well, in which is maintained a difference of potential throughout their entire length of from 1,000 to 2,000 volts. While the voltage in this class of circuits does not increase with the increase of the capacity of the dynamos from 650 to 8,000 and 10,000 lights, yet this increased energy is sufficient to afford ample food for thought to those on whom develops the duty of so insulating such circuits as to reduce the loss of energy to a minimum and prevent accidents to persons and loss by fire.

The same insulating supports, and practically the same insulating covering of the wires, that were used for overhead circuits of five arc lights, are used on circuits of 125 lights at the present day. The same style of glass insulator that is used for telegraph circuits is used to-day for arc light circuits with a difference of potential at the dynamo of between 6,000 and 7,000 volts, and for constant potential circuits with a difference of potential of 2,000 volts throughout their entire length.

The insulating covering of the wires differs in name only from that first used on the small 5 and 10 light circuits. That the insulation of high potential circuits has not kept pace with the increased amount of electrical energy maintained therein, no one can deny, and it is self-evident that perfect insulation will result in increased profits to electric light and power companies and increased immunity from loss and personal injury to the public.

How can this most desirable end be best attained? This is the problem to be met and solved. The manufacturers of lead-covered insulated wires and cables have succeeded in producing an insulation that meets the exacting requirements of the Boston Wire Department, viz., 20 megohms per mile per 100 volts. There is not an underground wire or cable used on high potential circuits in Boston, the insulation of which does not exceed this; but the question of how long this high grade of insulation can be maintained is yet to be determined. The almost perfect insulation of underground wires and cables has already been accomplished, and the question now to be met and answered is, Can the same grade of insulation be secured for overhead circuits?

My answer is, Yes, if the same grade of insulation is used, and No, if the present grade of insulation and construction is continued. If the same grade of wires used in the underground circuits is used, however, I would not advise any one to adopt this plan, as the proper place for such conductors is underground; and while the cost when compared with that of overhead construction is very great, the amount of energy saved, that is now lost, would, I believe, pay a handsome dividend on the money invested, to say nothing of the immunity from loss and injury of person, and the absence of vexatious damage suits.

I believe that all high potential circuits should be placed under ground, and I believe it can be done with ultimate profit to their owners. But we have, and I fear will continue to have for some years to come, overhead circuits, and I come now to the question of how to construct and insulate them.

I hold that all high-potential circuits should be supported on wooden poles and cross-arms, and the wires of all low-potential circuits excluded from such poles; and I do not believe it best to place such wires on fixtures placed on roofs or other portions of buildings, but if they are so placed, they should be beyond the reach of persons standing or working on the roofs.

I believe the so-called insulating covering in use at the present time for high-potential overhead circuits to be worse than a delusion and a snare. I believe it would be better to hang out the danger signal at once, by using bare copper wire, than to continue the use of this flimsy fraud that affords no protection to human life or property, but lures innocent people on to injury and death. Knowing the worthlessness of the material, it becomes necessary to use the best form of insulating supports. The present style of glass insulators is not what is required. Many of these insulators are only so in name. The very best grade of glass or porcelain should be used, and the double or single petticoat pattern, the form best suited to the purpose being that which will offer the greatest amount of dry surface between the wire and the supporting pin. These insulators should be supported on wooden pins.

Iron poles on any part of high-potential circuits should not be tolerated in any civilized community. They are a relic of barbarism that should be relegated to the scrap heap, and any attempt to patch them up only serves as a thin disguise to the danger that lurks within them. Twenty-five to forty feet of wood between the iron and the ground means that much insulation, while one hundred feet of iron only means what the glass insulator, wooden pin and cross-arm afford. The waste of energy due to the iron poles on the long circuits on which are placed 125 iron lamp poles, is simply enormous—so great that in rainy weather such circuits have to be cut in halves, in order to send sufficient current through the lamps.

Where such circuits are placed on the modern iron and steel structures they become a source of danger to persons who have occasion to handle these or other wires on the same or other fixtures.

Such circuits should not be run between the branches or through the foliage of trees, but when it cannot be avoided, the highest class of insulated wire should be used, and this encased in lead or iron. Any attempt at protecting this insulation from abrasion by covering it with tape or cotton braid is useless.

All that I have said up to this time applies with equal force to direct and alternating current circuits; but there are certain features of the latter that require separate treatment. As you know, a difference of potential of one, two or more thousand volts exists throughout the entire length of the primary circuit and between it and the earth, so that the danger from derived circuits to ground or from one side to the other is the same at a point one or more miles distant from the dynamo as it is at the brushes. Again, it is necessary for electrical and other reasons to run the wires in parallel and close together, in order that no other wires can be placed between them, and for convenience in making connections to the different transformers. Workmen and others can hardly pass between them without coming in contact with both of them, and for this reason I consider them far more dangerous than high potential series arc light circuits. As before stated, the covering of these wires affords little or no protection to those persons in dry weather, and none whatever during or immediately after rain storms.

1. Abstract of a paper read before the Electric Potentials, at Boston Nov. 25, 1895.

If these circuits are to remain above ground they should be separated so that both cannot be reached at the same time by any person; but this would involve the changing of nearly every existing circuit and a considerable increase in the cost of constructing new ones. Rather than adopt this plan, a high grade of lead-covered insulated wire should be used, and when that is done the proper place for them is underground.

The transformers should be placed beyond the reach of every one, and the primary wires that lead to them. The best way to do this is by placing the former in a stout wooden box, kept securely closed and well ventilated, and using high grade lead-covered insulated conductors. I believe the time is coming when all these circuits will be placed underground, and the transformers also. Instead of placing the latter on the outer walls and roofs of buildings and in some portions of their interior, they will be placed in suitable vaults beneath the streets and sidewalks, and each one will be of sufficient size to supply a large number of lamps or motors.

The danger to life from high-potential circuits comes from two causes—establishing a derived circuit from any one point thereof through the person to the ground and from the ground to some other point of the circuit, or by closing the circuit through the body. The danger from fire is mainly due to imperfect insulation.

The placing of the wires of alternating circuits underground removes one source of danger, but adds another not heretofore considered. On such circuits a second ground is not necessary to injure or kill a person who accidentally connects any portion of one of these circuits to the ground through himself. A person standing on or touching with one hand an iron pole, and with the other a bare or poorly insulated wire, or the iron case of a transformer that is in contact with the primary coil contained therein, will, owing to the failure of the insulation, surely receive a severe or fatal shock, although the circuit be perfectly free from "grounds." The reason for this is that the copper conductor is one, and the ground the other, plate of a condenser; and these plates readily discharge through any path of low resistance that is offered from one to the other. This, unlike the Leyden jar, is continually charged, owing to the alternations of the current; and the energy thus produced passes through the body of the unfortunate person who forms the connection from wire to earth, and vice versa.

To this cause may be laid the loss of one life at least; and in this case the circuit on which the accident occurred was clear of "grounds," with the exception of the one established by the unfortunate victim through the medium of an iron pole on which one of his hands rested, while the other grasped one of the primary wires leading to the idle transformer.

Tests of the circuit just previous to the accident proved it to be clear of any perceptible leakage to ground. This fact having been established, the question of how this man lost his life had to be answered. This answer was rendered after the following test had been made: A known resistance was inserted in a wire, one end of which was connected to ground, while the other was connected to one side of the circuit. The electromotive force was measured by means of a Weston volt-meter, and it was found that a sufficient amount of energy passed over the wire and through this resistance to instantly kill. From this you can see the necessity for the best possible insulation of the wires of these circuits and the greatest care in placing transformers, in order to prevent a recurrence of similar fatalities. (Discussion will be found on 557.)

TO DISTRIBUTE OIL BY PIPE FOR LIGHTING, AT LINCOLN, NEB.

It is stated that a company is being formed in Lincoln for the purpose of competing with gas and electric light corporations in illumination. Kerosene is to be used and distributed around the buildings in small pipes from a reservoir. Locally, J. F. Lansing is at the head of the movement. It is stated that a number of business houses in Lincoln are figuring on a change of base in the matter of illumination and employing the new process which will render explosions or fires cheap and easy.

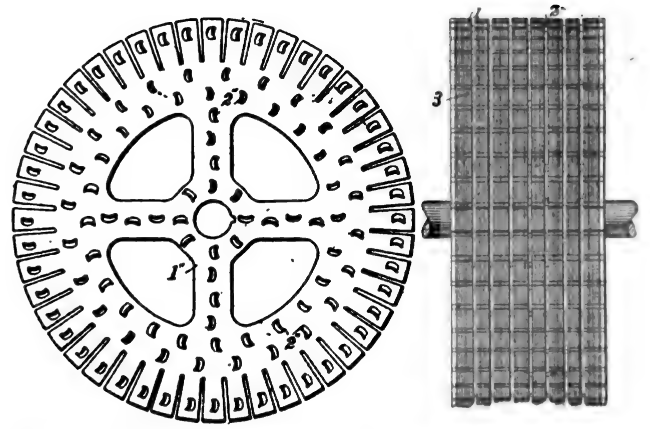
RESPONSIBILITY FOR INJURY FROM ELECTRIC LIGHT WIRE —A COLORADO DECISION.

The supreme court of Colorado has just rendered its first decision in a case involving the responsibility of a corporation controlling electric wires for injuries sustained by a person who receives a shock by coming in contact with them. A man passing through a public alley in Denver ran into a live wire which had been strung by the Denver Consolidated Electric Light Company. He was seriously injured and brought suit for damages. The company claimed in the first place, that no liability existed on its part and further that the man was guilty of contributory negligence. Both these points were overruled and the jury returned a verdict for $2,800 in favor of the plaintiff. The judgment was affirmed by the supreme court, which held that a corporation engaged in distributing electricity was bound to exercise extraordinary care and caution, its obligation in that regard exceeding that of a common carrier because of the dangerous character of the business.

WESTINGHOUSE METHOD OF VENTILATING ARMATURES AND CONVERTERS.

In spite of the improvements in design which have made the heating of armature and converter cores less formidable than was formerly the case, ventilation of these parts is always desirable. It has been suggested and the idea brought into practice in the past, to separate sections of the cores by washers, placed around the tightening bolts; but a more simple way is that for which a patent has just been granted to Mr. George Westinghouse, Jr.

Our illustrations, Figs. 1 and 2, show the manner in which an



FIGS. 1 AND 2.—WESTINGHOUSE VENTILATED ARMATURE CONSTRUCTION.

armature is built up according to this method. The armature disc, Fig. 1, it will be seen has lips or projections stamped up, which stand out at right angles from the main body of the disc. Any desired number of these lips may be stamped out. When the discs are assembled, one of these stamped up discs is inserted at the proper interval, as shown at 1, Fig. 2, so that when finally screwed up, a space free to the circulation of air will be left wherever such a disc has been placed. It will be noted that the lips are curved laterally in order to give them additional strength to withstand the pressure applied to the core.

THE ELECTRIC LIGHTING OF EDINBURGH.—III.

(Concluded.)

BY HENRY R. J. BURSTALL.

High-tension Engine Room.—The high-tension portion of the station consists at present of only two engines and alternators with their switchboard, and the rectifiers for arc lighting with their regulating arrangements and switchboard; but in the immediate future this plant will be considerably extended. Each of the alternators is driven direct by a Willans three-crank engine of 150 I. H. P. on the same bedplate. The alternators are of the "Portsmouth" type, with some modifications necessary owing to their increased speed of 450 revolutions per minute.

The exciting current is taken from the low-tension switchboard at 230 volts, and is only a few amperes. The alternators work at an electromotive force of between 2,000 and 2,200 volts, with a frequency of 52½ complete alternations per second. The main leads from the alternators, which are concentric, as well as the leads for the exciting current, are taken to the switchboard in chases similar to those in the low-tension engine room.

Rectifiers.—Opposite to the alternators, and standing on the same foundation block, are placed the Ferranti rectifiers for the series arc lighting. These are three in number, one for each of the two circuits, and one to spare. They each consist of a self-regulating transformer, of which the primary winding is connected to the omnibus bars of the high-tension switchboard, and the secondary winding is connected through a commutator and distributing switchboard to the arc lamps. One winding is hung on knife edges in a frame, and is capable of movement nearer to and further from the other; this automatically keeps the current in the secondary winding constant at 12 amperes, varying the electromotive force to suit the number of lamps in circuit. The current from the secondary winding of the transformer is then changed, by a commutator driven by a synchronous motor, from an alternating current to a uni-directional pulsating current, which is distributed to the lamps. A small distributing switchboard is placed close to the rectifiers, by means of which any rectifier can be put on to either of the high-tension omnibus bars, and either circuit of arc lamps can be put on to any rectifier; and provision is made on this switchboard for extending the number of arc lamp circuits.

Distributing Mains.—Practically the whole of the distributing

mains are laid as cable insulated with india-rubber, heavily braided, drawn into Doulton stoneware casing under the footways, and into either Crompton-Davis cast-iron casing or cast iron pipes under the roadways. At all crossings, and at intermediate places on the footways, brick junction boxes are built for the purpose of drawing in, connecting and testing, and smaller brick boxes are provided at suitable intervals, where connections are made to consumers; but for this purpose, when space is limited, a special length of Doulton casing is provided, which is so made that it can be easily split longitudinally and removed; the house connection is then made with vulcanized joints, and the casing replaced and jointed up with a special collar and bitumen cement. The collar is provided with a socket, into which the pipe carrying the house connection can be jointed.

Feeders.—Wherever sufficient space has been found under the footways, the feeders have been laid as bare copper strip, carried on stoneware insulators in concrete culverts. Across all roads, and where there has not been sufficient space for culvert, the feeders are laid in Siemens armored cable, laid direct in the ground with a tarred board over them to act as a protection to them and as a warning to any workmen opening the ground. The cable has everywhere been laid of greater section than the copper strip in the rest of the feeder, so that the capacity of the feeder can be largely increased, and yet the resistance be kept right, by pulling in additional copper strip into the culverts, without bringing the current density up to any excessive amount in the portions laid in cable. Thus the feeders can be made to carry considerably more current than that for which they are now designed, with the same drop of electromotive force, and without either disturbing the streets or over-running any of the cables. All the feeders have been designed to have a total drop of 44 volts at full load.

Potential Leads.—These lines, by which each feeding point is connected back to the station, consist each of three sets of wires, insulated with specially prepared paper, laid up together, and covered with the same material, a lead tube being drawn over the whole, These leads are drawn into special ways, either in Doulton stoneware casing or cast-iron pipe, laid alongside the culverts; and are joined up into one length back to the station. The joints are made in a brass tube, soldered on to the lead sheathing, and containing insulating oil; the wires are kept separate from one another by fibre discs.

Public Lighting.—The streets in which there are low-tension mains are lit by electricity, by means of altogether 176 public arc lamps. The arc lamps are run four in series off the distributing mains; and each series of four is provided with a fuse, switch, and line resistance. Each lamp in the series is also provided with an automatic device, which, in the event of the lamp failing, cuts it out and introduces into the circuit a resistance equal to the lamp, so that the other lamps in that circuit are not affected. The lamps in Princes street are constructed for a normal current of 15 amperes, and all the other low-tension lamps for 10 amperes.

In the streets, in which no low-tension mains are laid, the lamps are run on special high tension series-circuits from the rectifiers at the station. There are at present two series-circuits, both of which are laid in all the streets lit by high-tension lamps, and the lamps are connected alternately to each circuit. The circuits are laid as concentric cable drawn into cast-iron pipes, the outer conductor of the cable being insulated. There are 24 lamps on each circuit, each provided with an automatic cut-out in case of its failing to act; and also with a switch in the pillar, by which it can be entirely disconnected from the circuit if necessary, while the switch is so made as to complete the circuit for the other lamps.

In arranging the circuits for the arc lamps, care has been taken to put alternate lamps on separate circuits in all streets, whether run from the distributing mains or from the series circuits. This minimizes the risk of any street being left in darkness by the failure of any circuit, and also allows half the lamps to be switched off at or about midnight, still leaving the streets well lighted. The arc lamps are of Crompton-Pochin type, and are fitted with 18 in. spherical globes. They hang from the bracket of a cast-iron pillar, the center of the globes being 23 ft. above the level of the pavement. In Princes street the lamps are about 45 yards apart, and are on one side only of the street. In the other parts of the city the lamps are about 60 yards apart, and are placed alternately on the two sides of the street.

PHILADELPHIA CITY LIGHTING.

At the beginning of this year Philadelphia was being illuminated nightly by means of 5,293 arc lamps, at an average cost of $41\frac{1}{10}$ cents a lamp, or $150.86 a year for each electric light. This meant an outlay of $788,700 for this year. On the first of August, however, 878 new lamps were added, raising the total to 6,171 arc lights and increasing the public expenditure in this regard to $921,155 annually. According to the latest public statement of the municipal electric statistics, City Councils are paying 40 cents and more for each of all but 2,203 of these 6,171 lamps, 45 cents a night each for 818 lamps and 47 cents and more each for the remaining lamps. The scale runs up to 47½ cents a lamp.

LITERATURE.

Polyphase Electric Currents and Alternating Current Motors. By Silvanus P. Thompson. New York, Spon & Chamberlain. 1895. 261 pp. 5¾ x 9. 2 plates. Price, $3.50.

In the last volume of the author's great work, "Dynamo Electric Machinery," considerable space is devoted to alternate current machinery, but the large amount of work especially in the field of polyphase currents, done since its publication in 1892, as well as the demand for information specially relating to this subject, makes the appearance of the present book particularly timely. Like the work referred to above, the present is also the outcome of a course of lectures delivered by the author, which have been enlarged and supplemented by much valuable information obtained directly from designers and manufacturers.

We notice at the outset a remark of the author's that the subject has received very little attention at the hands of English electrical engineers, and that most of the work done in polyphase distribution has been done outside of England. It would be interesting to know the cause for this lack of attention on their part, and we believe that one reason may be found for it in the fact that the tendency in England at the present day seems rather strong in favor of the employment of the continuous current. So far as power transmission is concerned, the dearth of water powers in England may, perhaps, largely account for the neglect of the polyphase current, at least in its relation to long distance transmission, but aside from this we notice an unmistakable tendency among English electrical engineers to the stretching of the continuous current to its ultimate limit for distribution. Perhaps Lord Kelvin's undisguised antipathy for the alternating current may also have its influence here. But that the polyphase current has come to stay and to grow in usefulness no one who follows the signs of the times will, we think, be prepared to deny, even in England.

The work begins with a chapter on polyphase generators, in which the analogy between polyphase and single phase alternators is made use of in explanation of the former. It is interesting to note that in this chapter reference is made to two large two phase alternators, installed at the Paddington Station, London, by the late J. E. H. Gordon, which have been running since 1888. Both these generators, like one of Mr. Gramme's early types, distributed currents independently to two circuits, each operating with single-phase, so that polyphase work can hardly be traced back to these machines. Embodied in this chapter are descriptions and details of the three-phase generators and motors employed in the celebrated Lauffen-Frankfort distribution in 1891; the 750 K. W. two-phase Westinghouse alternators exhibited at Chicago; the Brown umbrella type and those of the latest Niagara alternators, as well as others.

The various combinations of polyphase currents in star and mesh groupings are next taken up by the author, who here also discusses the economy of copper in the use of the polyphase system. In this connection he refers to the controversies which have been carried on on this subject, and says, very truly, that the conflict of opinion is due to the circumstance that the various disputants have taken different criteria as the basis of comparison. For his own purpose Prof. Thompson distinguishes broadly between high pressure and low pressure systems in the discussing of this question, and shows how the economy varies under different conditions of working. He gives also a table of economies, put forth by Mr. Goerges, in his paper read before the Berlin Elektrotechnische Verein, which assigns the highest economy to the three-phase system having four wires with the neutral wire from the common junction, which figures at 29.2, as compared with 100 for the single-phase system for two wires.

The combination of magnetic fields is very clearly explained by graphical methods, and Deprez's theorem of the production of a rotary magnetic field is also given and explained by the mechanical analogy of the 2-crank engine; while the three-phase field is similarly explained by the analogy of the 3-crank engine. In introducing the properties of the rotating magnetic fields the author goes back to Arago's experiments on the rotation of the magnetic field, as well as those of Barlow, and others, which form a very interesting historical account, and we notice here the description of a very simple piece of apparatus for performing a number of interesting and easy magnetic rotation experiments, which ought to be valuable in class-room demonstrations.

Coming to the early developments of the polyphase motor itself the author brings forward as the first induction motor the elementary machine built by Mr. Walter Baily, exhibited before the Physical Society of London, in 1879, in which a disc was made to rotate under the influence of currents sent alternately through two pairs of magnets placed below it. We also find the description of the Deprez apparatus for obtaining synchronism with two-phase currents acting on two independent armatures, one having an angle of 90 degrees relatively to the other; the movement in both motors was effected with artificial two-phase currents produced by commutators from a battery. The author points out that Deprez's apparatus does not embody the principle of the modern rotary field, whereas Baily's does. The researches

of Prof. Ferraris in 1887 naturally come in for description at this point, as well as those of Borel, Coerper, and finally the work of Mr. Tesla, which is very fully described. The author quotes very fully from Mr. Tesla's patents and seems to have been at particular pains to set this inventor's work clearly before the reader. The work of other inventors, such as von Dolivo-Dobrowolsky, Wenstrom, Lahmeyer, Bradley, etc., is also alluded to.

In the chapter devoted to the structure of polyphase motors the author presents the various forms and windings which have been given to the stationary and moving parts of polyphase motors, which form a very interesting comparison. The value of this portion of the work has been greatly enhanced by the publication here of the researches of Mr. C. E. L. Brown, made early in 1890. Mr. Brown had a number of rings constructed all of the same diameter, wound in different ways, but all adapted to receive about an equal excitation by three-phase currents, and also a different number of rotors adapted to run on any of the rings. Four rings were used: (*a*) The hole-ring, (*b*) the smooth ring, (*c*) the fine tooth ring and (*d*) the coarse tooth ring. Four different rotors were made respectively as follows: (*A*), a solid cylinder of wrought iron pierced with holes; (*B*), a massive wrought iron, double-T form like a Siemens shuttle-armature, but without any windings; (*C*), a laminated iron cylinder built up of core discs, pierced with holes just within the periphery, and furnished with stout copper rods, all short circuited at the ends; (*D*), a massive wrought iron cylinder surrounded by an outer cylinder mantle of copper. Besides these there were others of various structure and different material, such as steel, wrought iron and cast iron. Of all these various rotors the laminated double-T proved the worst, refusing to run under any load. The solid cylinder of wrought iron was much better than that of cast iron, while the cylinder with the copper mantle surpassed both, whichever ring was used externally. The best form of rotor, whichever ring was employed, was found to be the laminated cylinder having the copper squirrel cage. We are glad to note here that the author has adopted the terms *rotor* for the rotating part, and *stator* for the stationary part of such machines. Much confusion has been created in the past in this respect, and we hope that writers on the subject may hereafter employ these designations, even if they don't like them.

In the two chapters devoted to the elementary and analytical theory of polyphase motors, the author takes up general relations between the speed and revolution of the magnetic field, the speed of the revolving part of the machine, the resistance of the circuits, the torque and efficiency of the machine, and in the analytical part he follows the theory of M. Potier. Monophase motors also come in for a chapter, but little seems to have been done in this direction, compared with the prominent place such a machine would take if a good working apparatus of this type were brought out. Under the head of miscellaneous alternate current motors we find descriptions of a number of machines which have come into use, and some which have been constructed as experiments.

The remaining part of the work is devoted largely to notes on practical designs, and the results obtained in actual practice with polyphase motors, together with tests which throw considerable light on the action of these machines. Additional value is lent to this part by the two plates added at the end of the work, one of which is a drawing to scale of a 6 H. P. two-phase motor, built by C. E. L. Brown, and a 5,000 volt 3-phase motor.

Perhaps as valuable a part of the work as any is the appendices, one of which gives a complete bibliography of polyphase currents, and rotary field motors Every one who is interested in this class of work, whether beginner or experienced designer, will find this index of the greatest possible value. Those who are interested in the patent side of the question will also find in Appendix II. a record of all the schedules of British patents bearing on polyphase and alternating current motors, beginning with the year 1886. The work as a whole presents the best record of the state of this department of the art at the present time, and hence will be welcomed by all students and workers. It is still perhaps too early to look for a complete and exhaustive work on this subject, but the author has certainly presented what there is available in the field of which he treats. Like all his previous works this will also become an indispensable necessity to all pursuing the subject.

"THE ELECTRICIAN" DIRECTORY.

The 1896 edition of the above excellent handbook is now going through the press, and we have been requested to ask that all slips, data, etc., shall be promptly forwarded to the London office, revised and corrected, so that no delay or omission may occur.

"EXCELLENT IN EVERY WAY."

Mr. Frank B. Rae, E. E., of Chicago and Detroit, writes: "The Data Sheets are excellent in every way, and THE ELECTRICAL ENGINEER is to be congratulated upon its enterprise in producing them in a manner affording such a ready means of reference to the information needed daily by the electrical man in almost any capacity."

LETTERS TO THE EDITOR.

FEATURES OF MUNICIPAL LIGHTING AT DETROIT.

Answering your editorial inquiry of the 20th under the head "Untrustworthy Electrical Mechanisms," I beg to say, that the figure you name, ¼ of one per cent. of the total, is not an unreasonable proportion of lights out in a well managed arc lighting plant; it being understood that the lamps are street lamps, exposed to the usual contingencies of outdoor use.

Noting further your comment on the Detroit figures, I beg to call your attention to the fact that the total of 1,040 hours of outs for the month of October is just ¼ of one per cent. of the lighting hours for the said month. You seem to have mis-understood these figures. They mean that there were 152 reports of "outs," an average of less than 5 reports a night and that the *total* hours out *for all reports* is 1,040.

You will note further, that the proportion of lights out in an arc lighting plant is not necessarily any indication of the reliability of the arc lamp mechanisms. The 1,040 hours above referred to include lamps reported out which had not a ghost of a chance to burn, some of them having been missed entirely by new trimmers, and others having been switched out of circuit by patrolmen to permit the clearing of line troubles, for which neither the lamps nor the lines were responsible. The lamp mechanisms in this particular month could not be blamed with more than one-half of the total "outs," and in a larger number of instances in which lamp mechanisms were responsible the lamps had been in service for six months previously along the line of railways using soft coal and in similar dirty locations, and only needed cleaning to make them operate perfectly.

Will you let me say incidentally that a large number of the taxpayers of Detroit object to the principle of municipal lighting, yet believe and say that it was, in the special case of Detroit, the only remedy for bad service and for high rates. And, further, that very few tax-payers in Detroit (or, indeed, anywhere) imagine that a municipal lighting plant is necessarily more economical than lighting by contract. They can see that in Detroit one single lighting company, honestly capitalized, honestly managed and seeking only a reasonable profit could have done and could do the entire lighting of the city, both public and private, at less cost than three independent lighting companies and one municipal plant are doing it now.

They also see the corollary, that one municipal plant, honestly capitalized and honestly managed, could do all the public and privating lighting at less than either costs just now; but they look first to the private companies for such improvement in service and reductions in price as are justified by improvements in the machinery and reductions in cost of operating made in the last few years. Hence the limitation of the Detroit municipal plant to the lighting of streets and public buildings. Whether this limitation will continue depends upon the private companies. If they should fail to keep in touch with their patrons—if there should come about such a condition of bad service and high rates as prevailed in the street lighting—the cry for the municipalization of all lighting will be heard again, and will not be downed by any belated concessions. If, then, it is seen that the public lighting has been well and cheaply done by a municipal plant, the extension to private lighting will be inevitable; and the process that you call "confiscation" will be looked on by those same conservative taxpayers not as robbery, but as self-defence against robbery.

But from such a time of cross purposes, of ill-feeling, and of misrepresentation as will—as must—accompany such a change, I say, "Good Lord, deliver us."

ALEX. DOW,
Engineer Detroit Public Lighting.

DETROIT, MICH., Nov. 22, 1895.

QUESTIONS FOR A LEISURE WEEK.

KINDLY answer the following either personally or through your columns:—

1. How many heat units in the ordinary carburetted hydrogen gas? 2. How many (the maximum) in the electric current? 3. The greatest number that can be produced by the combination of hydrogen and oxygen gases? 4. How many units of heat are necessary to run aluminum from the richest clay? If you answer in units, please state whether French or British. State the answers in degrees also.

W. J. F.

CHICAGO, ILL.

GOOD EDUCATIONAL WORK.

"YOU will greatly oblige by sending me the back sheets of Data Sheet Supplement, which I prize very highly. * * * Please send sample of leaflets of electrical education course. You have struck a capital method for diffusing electrical knowledge." Rev. John Wilson, Jasper, Ontario, Canada.

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CONTENTS.

THE NATIONAL ELECTRICAL EXPOSITION.

PLANS that have been under discussion for some time past have now matured, and the proposal to hold an electrical exposition in New York city has assumed definite and tangible shape. Next May, all going well, we shall have here, under the auspices of the National Electric Light Association, one of the best special exhibitions that has ever been seen in this part of the United States. This seems to us a subject of congratulation, for New Yorkers know very little about the general subject of electricity, and no attempt has ever been made to educate them on the subject, except by the New York Electrical Society in the modest and clever little exhibit that it made some years ago while unfortunate enough to be one of the annexes of the "American Institute," at the time when that curious body hippodromed in the old shed up on Third Avenue. The present attempt is not only vastly more ambitious, but is made opportunely, and the arrangements are such as to promise a brilliant success, equal to, if not exceeding, that of the International Electrical Exhibition at Philadelphia in 1884.

We consider it fortunate that the National Electric Light Association, while sharing in the results of the exhibition, will not be directly responsible for it financially, and will not be burdened with functions that are far beyond its legitimate sphere. As an organization based upon the use of current from central stations and isolated plants, it cannot but have the kindliest feelings toward, and receive immense benefit to its individual members, from a show the main idea of which is to teach the public how many, varied, convenient and delightful are the uses to which electric light, heat, power, cooling, sanitation, &c., can be put. But it is not wise that the Association should go into commercial enterprises, and for that reason we are glad to see that the risk is entirely assumed by an Exposition Company, and that the necessary funds are already subscribed. It may be criticised that the shareholders stand to make a handsome thing out of it. That is true; we hope they do, for they also stand to lose. Most of them are known as public-spirited men, deeply interested in the welfare of electrical industries, and likely to give in time, thought and work the full equivalent of any dividend they may draw. We can the more heartily and frankly say this because we have no shares in the company and do not propose to hold any. Our support is entirely on the ground that we believe in the Exposition as an excellent way of reaching the public.

The Grand Central Palace is an admirable place for such a show as is proposed,—light, airy, large, well situated, and already equipped with good apparatus. It seems to us that at such a place not only can a splendid display be given, but that much educational work can be attempted on broad popular lines, especially among the young, in the shape of brief lectures, experimental demonstrations, and throwing open the doors as much as possible, of the various conventions that will be held while the Exposition lasts during the month of May. The National Electric Light Association will meet one week; it is hoped that the American Institute of Electrical Engineers will take another week; and so on; this plan in itself providing for a nucleus of solid, useful work in the profession and art

alike. In Philadelphia, in 1884, the public school children thronged the exhibition, and we trust that young New York will now be given an equal opportunity.

We have only one word of caution to offer the company:—that is that they exclude with the utmost rigor and severity all fakes and swindles, and that they will allow no temptation to be strong enough to open the doors to anything that partakes of the nature of quackery and charlatanism. This intention we credit them with, but there will be no small amount of vigilance necessary to keep their confidence from being abused. Granted that the exhibition is free from blots of the character intimated, and knowing as we do the promptness with which large exhibitors are already securing space, we venture to predict brilliant results for the May Exposition. It is badly needed, in this city, where there are hundreds of thousands of people who do not know how electricity is generated; how telegraphs and telephones work; how wires and cables are made; why trolley cars run; what constitutes a primary or a storage battery; why an electric motor has so many uses and advantages; the difference between arc lights and incandescent; the methods of electro-deposition and electro-chemistry; the strange and beautiful effects obtainable with electric lights and fountains—in fact, there is not a branch of electrical industry about which the public is well informed or for which the Exhibition will not secure new customers and new markets.

INSULATION vs. POTENTIAL.

The employment of higher and higher potentials by electrical engineers to carry out their plans for economical transmission of current has of necessity required a constant increase in the insulation of the conductors to maintain the integrity of the system. The battle between insulation and potential, indeed, recalls strongly to mind the continued struggle between guns and armor. No sooner has a gun of increased power been designed than an armor is produced capable of resisting it, only to result in a later defeat of the armor by improvement in gun manufacture. In the paper read by Capt. Wm. Brophy before the Electric Potentials, at Boston, there is much food for thought, and not a few hints to manufacturers of insulating material. The insulation of underground wires, according to Capt. Brophy, has reached a point where little improvement seems needed, as attested by the excellent showing made by high potential underground lead-covered wires in most of our large cities; but even here the time element, according to Capt. Brophy, is still the uncertain factor. But it is more particularly with regard to overhead circuits that Capt. Brophy finds that the march of improvement in insulation has not kept pace with the requirements of the potentials used at the present day. Those who have followed this question will, we think, agree with Capt. Brophy as to this fact. His credo as to how a high potential overhead circuit should be insulated will bear close study. Perhaps the most essential point in Capt. Brophy's statement is his insistence on the abandonment of iron poles for wires carrying high potential, and the substitution therefor of wooden poles. May not the aversion here exhibited for the metal support be due to the inferiority of the insulators, which Capt. Brophy himself points out must be abandoned in the future if the current is to be confined to the lines with safety and economy? The present forms of ordinary insulators largely used have been shown by experience to be inadequate for the purpose to which they are applied, and it has been shown that not only better materials, but that forms of insulator better adapted to shed the water and moisture, are absolutely necessary. But given the employment of the high class insulator, does it follow that the iron support is a sine qua non of insulation? We could mention a number of installations in which iron poles are employed with success and as one example may recall the Tivoli-Rome transmission, in which alternate current at 10,000 volts is transmitted a distance of nineteen miles on conductors strung on iron poles for the entire distance. So far as our information goes, no difficulty has been experienced from lack of insulation of these lines, and we must therefore ascribe the success to the employment of the proper form of insulator. We take it, however, that the restrictions which Capt. Brophy puts upon the use of iron poles, may be justified when one considers the loose methods of construction which are unfortunately still prevalent. He says very truly that twenty-five to forty feet of wood between the iron and the ground means that much insulation, while one hundred feet of iron only means what the insulator, wooden pin and cross arm afford. Viewed broadly, however, the danger which Capt. Brophy points out is not, so far as this country is concerned, one to cause general alarm, owing to the fact that iron poles have come into but very little use for the support of high potential circuits, in which we do not include electric railway conductors. The wooden pole continues to be so much cheaper that it is still the standard type, at least in this country, and it is only in cities of the first class practically that iron poles and lamp posts have found any extended employment.

Regarding the danger from converters run from alternating circuits placed underground by contact even with the thoroughly insulated circuit, we think the application of a grounding device such as the Cardew, largely used in England, would have made impossible the accident to which Capt. Brophy refers in his paper. The practice of grounding the converter case would also remedy the difficulty, but is not generally employed in order to avoid the additional strain which is thereby placed upon the insulation. We are glad to believe, however, that the plea for better insulation which Capt. Brophy's paper puts so strongly will again call attention to this all important subject.

THE CHICAGO MOTOCYCLE RACE.

As far as we can make out, the Chicago motocycle race on Thanksgiving Day ended in a fizzle, although the weather is perhaps to blame for that. It was a pity to hold the race so late in the year in such a northern region. Our Chicago correspondent says: "All the carriages had to be pushed along the Midway for over a mile, as the snow is about a foot deep there;" and he describes in a private letter how he and others followed in a four-horse sleigh, giving help of one kind and another. That is hardly our idea of a race, and proves nothing as to the capacity of any horseless vehicle—electric or otherwise. We hope soon to see a race that is a race, under decent normal conditions, on good, clear roads, free from foot deep snow and knee deep mud; and we trust that such a competition may be organized in New York next spring.

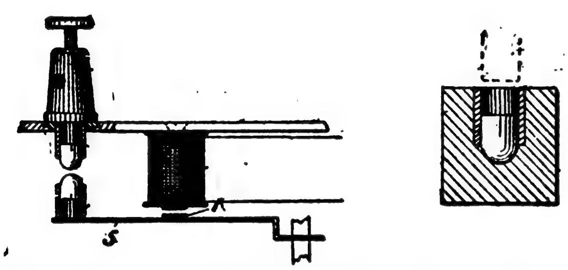
Telephony and Telegraphy.

WURTS' NON-WELDING CONTACT FOR RELAYS.

Relays, such, for example, as those employed in connection with electrical signaling systems, contain small contacts which are brought together and separated quickly by means of slight actuating forces. The separating means, usually a spring, is so weak that the contacts are liable to stick together, particularly during thunder storms, when the passage of static discharges from one contact to the other forms what might be called a "weld." This apparent fusing together of the two metal contact-pieces is a very serious defect, since it renders the instrument inoperative. It is customary to make the tips of the contact-pieces of platinum; but even when constructed of such material the difficulty above mentioned is not avoided, from which it seems probable that the sticking together of the contacts is not, properly speaking, due to fusion, but is rather a sort of interlocking of the parts, which is independent of temperature.

In experimenting to obviate this difficulty, Mr. A. J. Wurts has found that an amalgam contact formed by electrolytically depositing copper into mercury remains entirely free from "sticking" and at all times allows of a complete break at the contact.

The illustration, Fig. 1, shows the method of mounting the



Figs. 1 and 2.—Wurts' Non-Sticking Relay Contact.

amalgam contact and Fig. 2 illustrates the manner in which the amalgam plug is formed by pressure in a mold.

Just what the action of the amalgam is by virtue of which it obviates the welding or locking together of the contact-tips is not absolutely certain; but it seems possible that the action is similar to that of tapping with the feet upon moist sand, which brings the moisture to the surface; that is to say, the passage of static discharges may instantly bring more or less free mercury to the surface, which acts to prevent the interlocking of the devices. Whatever may be the true theory of the operation, it has been practically demonstrated that the result is as stated.

A SKETCH OF THE ERIE TELEPHONE SYSTEM.

The Erie Telegraph and Telephone Co. owns a 65 per cent. interest in the Cleveland Telephone Co., a 70 per cent. interest in the Northwestern Telephone Exchange Co., and a 70 per cent. interest in the Southwestern Telegraph and Telephone Co. the remaining interests in the above-named companies being owned by the American Bell Telephone Co. These companies operate exclusively under patents owned by the American Bell Telephone Co. in Cuyahoga Co., Ohio, which includes the city of Cleveland, the states of North and South Dakota, excepting the Black Hills district; the State of Minnesota, excepting the city of Duluth; all of the States of Arkansas and Texas. Taken collectively they make the third largest telephone system in the United States. The headquarters of the Erie corporation are at Lowell, Mass., with branch executive offices at Cleveland, Ohio; Minneapolis, Minn.; Little Rock, Ark.; Dallas, Tex., and Austin, Tex. The branch offices are in charge of General Manager Mr. J. P. McKinstry and division superintendents.

The executive officers of the corporation are: Levi Sprague, president; Charles J. Glidden, secretary and treasurer; James P. McKinstry, general manager.

In the directory of the sub-companies the American Bell Co. is represented by John E. Hudson, president; Thomas Sherwin, auditor, and Col. D. B. Parker, of Buffalo, N. Y.

The company had in operation Sept. 30, 1895, 60 exchanges, 210 toll stations and 17,812 subscribers. Its systems of long distance telephony extend from Clarksville to Galveston, via Austin, in Texas, with branches east and west, touching all principal cities and towns. In Minnesota lines run between Minneapolis and St. Paul, South Lacrosse, Wis., and Mankato, Minn.; north to Stillwater, St. Cloud and Little Falls, and all intermediate points. In North Dakota, Fargo to Grand Forks and points between. There are also lines west of Fargo and Hillsboro, connecting important towns.

In Ohio all the principal cities and towns in Cuyahoga Co., with Cleveland, aggregating in all over 6,000 miles of long distance copper wires. In the exchange system there is in use 25,000 miles of wire, making a total of 31,000 miles, of which 10,000 miles are underground. The company has two buildings at Cleveland, one completed, one in process of construction; one at Galveston, one at San Antonio, at present $200,000 invested in real estate. It will spend this year fully one-half million in extensions, and will, it expects, add more new subscribers than during any one year of its history.

The company's capitalization of $4,800,000 (par $100), and bond issue of $1,000,000 is smaller than has any other company of its size. The sub-companies have not one dollar of indebtedness. The company has paid to date 48 dividends, is rapidly increasing its business and is considered one of the best managed corporations in the United States.

WESTERN UNION OUTLOOK.

The returns from the Western Union test offices indicate an increase of about $25,000 a week in receipts, but this does not appear to have a very favorable effect on the stock or on Wall Street, owing to the recent decision throwing open railway lines to other companies and to the early expiration of the Bell telephone contract. Speaking on this subject, the *Boston Herald* remarks:—"Bear pressure on Western Union stock was again noticed, and it was once more remarked that the company might find a formidable competitor in the American Bell Telephone Company at the expiration of the contract between the companies one year hence. The Western Union realized some $450,000 from that contract the past year. This source of revenue will be lost to Western Union. The telephone company already does a telegraph business in a limited way, and at a small cost could enlarge the business tremendously, using the telephone to transmit messages to and from central offices to all of its customers, and installing telegraph instruments in its various exchanges. If the Berliner patent should be finally overthrown, the telegraph company could retaliate in kind by doing a telephone business, but it is believed to be poorly equipped for that business, whereas the telephone company is superiorly equipped to do a telegraph business.

"The Western Union Company does a gross business of $22,000,000, the Postal Company does $4,000,000. If the telephone company should do 20 per cent. of $26,000,000, say $5,000,000, and save one-half of that, it would add a fine sum to its own income, which is now $3,900,000, or perhaps $4,000,000 net. Of course, this is looking ahead, but it is not viewing an impossibility."

PAY STATION TELEPHONE SIGNS.

A ruling of considerable importance to the New York and New Jersey Telephone Company has been rendered by Recorder Stewart in Paterson, N. J. This company has a large number of telephone pay stations in Paterson, and advertises them by means of signs placed on their poles near such stations. There is a local ordinance which prohibits signs from being swung in public highways. Under this ordinance the company was charged with placing their signs on the public highway, and Mr. John F. Noonan, the company's local manager, pleaded guilty to having had the signs placed on the poles, but believed he had the right to do so as long as they were eight feet above the sidewalk. The recorder ruled that such right could not be employed by any person or corporation. The case was set down for a hearing on Dec. 5. Mr. Noonan promised to have all the signs removed by that time.

GOVERNMENT TELEPHONY.

It is given out at Washington that Postmaster General Wilson in his annual report will recommend the appointment of a commission to investigate thoroughly the feasibility of adopting the telephone as an important adjunct to the mail service. The plan does not involve government ownership of the telephone lines, but the making of contracts with the private corporations or carriers, to handle the public business the same as it contracts with railroad companies and coach lines to handle its mails. The government will sell stamps at a popular rate, say 2 cents for a single telephone message, or 5 cents for a message and return, the public having the advantage of a uniform rate to all points.

BAXTER OVERLAND TELEPHONE CO.

Justice McLennan, in special term at Syracuse, N. Y., appointed Hon. C. M. Dennison, of Whitesboro, receiver of the Baxter Overland Telephone and Telegraph Company on the application of John M. Graham, a stockholder. A. W. Mills opposed the motion. It is said the franchises of the company will be offered for sale shortly, a new organization effected and a telephone company organized.

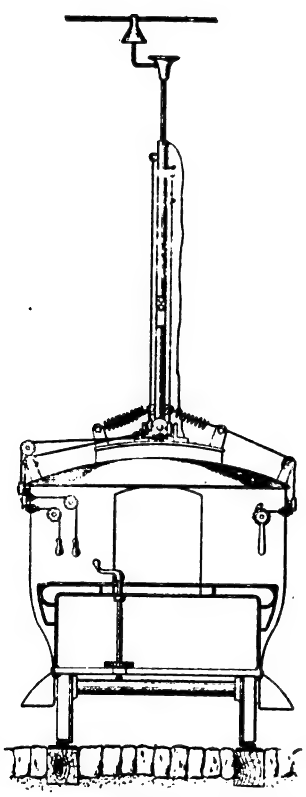
Cairo, Ill.—The Cairo Telephone Company has been formed; capital stock, $5,000; incorporators, Thomas W. Gannon, Angus Leek and Frank J. Fitzgerald.

ELECTRIC TRANSPORTATION DEPARTMENT.

THE WESTINGHOUSE SIDE-CONTACT TROLLEY WHEEL.

The trolley and its accessories have given rise probably to as many modifications as any one of the other numerous details which go to make up the electric railway system of to-day. Early work began with the overrunning trolley which, however, was soon found to be ill adapted to the task and hence was soon followed by the underrunning contact which is at present in universal use. Like many devices of the kind in electrical work, which have proved successful, the underrunning contact has given rise to litigation, and inventors have been at work to devise other adequate and practical means. A recent striking example of this is exhibited in a patent issued to Mr. George Westinghouse, Jr., which describes a trolley designed to make contact with the side of the trolley wire.

The accompanying illustration shows the method. As will be



Westinghouse Side-Contact Trolley Wheel.

seen, the trolley wheel, if it may be so designated, is of a tapering inverted-bell form, having a wide flange which extends above the top of the trolley wire. The trolley pole on which the wheel is mounted swings in a plane at right angles to the direction of the car so that it is always pressed toward the side of the wire. The arrangement is such that by suitable springs the wheel can be made to effect contact with either side of the wire. Suitable arrangements also provide for variations in the height of the wire. The tension of the springs controlling the contact trolley is effected by cords under control of the motorman.

PREPARING FOR THE ST. LOUIS CONVENTION.

Representatives of the different St. Louis street railway companies met at the Mercantile Club recently and formed an organization to entertain in a befitting manner the members of the American Street Railway Association, when they meet in annual Convention in that city next year. Robert McCullough, Vice President and General Manager of the Hamilton syndicate, was elected President; Harry Scullin, Vice President and General Manager of the Union Depot Railway Company, Vice President, and Robert Lehmann, Secretary of the St. Louis and Suburban Railway Company, Secretary and Treasurer; P. C. Maffitt, President of the Missouri Railroad Company; George W. Baumhoff, General Manager of the Lindell line, and Joseph S. Minary, General Manager of the Southern Electric line, compose the Executive Committee, with the President ex-officio Chairman. The committee was empowered to appoint all the sub-committees it deems necessary. It is proposed to entertain in worthy style the 1000 or more persons who will be in attendance. The exhibits of street railway apparatus and supplies will, it is hoped, be the largest ever made.

THE BOSTON WEST END SYSTEM.

The eighth annual report of the West End Street Railway Company was issued last week, and shows a handsome increase in both gross and net earnings. The actual gross increase in revenue was even greater than estimated, being $922,291 as against a gross increase of $131,301 for 1893–4. The gross earnings for the year ending Sept. 30, 1895, were $7,746,170, compared with $6,823,879 the year before, an increase of $922,292. Operating expenses were $5,633,163, compared with $4,807,083 in 1894, an increase of $826,080. This reduced the net earnings to $2,113,007, an increase of $96,211 for the year.

Following is a table giving the financial showing of the road:

	1895.	1894.	Increase.
Gross	$7,746,171	6,823,879	922,292
Expenses	5,633,163	4,807,083	826,080
Net	2,113,008	2,016,796	96,212
Taxes	325,288	280,167	45,121
Int. and r'tls	421,675	444,897	*23,222
Fixed charges	746,963	725,064	21,899
Balance	1,366,044	1,291,732	74,312
Dividends	1,102,525	1,057,100	45,425
Inc'm. balance	263,519	234,632	28,887
Accts. written off	222,823	136,275	86,548
Surplus	40,696	98,357	*57,661

*Decrease.

In his general remarks, which are more extended than those of last year, Pres. Samuel Little outlines what has been accomplished by the West End in the past 12 months, and says:

"The act of the legislature compelling the placing of electric wires underground in a certain defined district of the city, affected this company to the extent of requiring all of its wires to be buried in the district named, except the trolley wires. The act of the legislature required the commissioner of wires to designate the sections of this district upon which work should be accomplished each year, which section could not be more than one-fourth nor less than one-sixth of the whole district.

"The work already completed exceeds the requirements of the commissioner for the first two years; 2.24 miles of conduits, containing 41.07 miles of duct, have been constructed, in which have been placed 23.31 miles of feeder cables and 13.98 miles of return feeders. The construction of the conduit and cable system takes the place of the overhead feeder wires.

"A contract has been made for electric heater equipments for the balance of the entire box car equipment of the road, which will all be installed and in operation the coming winter."

The present equipment is as follows: Box cars, horse, 371; open cars, horse, 170; box cars, electric, 16-foot bodies, 92; box cars, electric, 20-foot bodies, 336; box cars, electric, 25-foot bodies, 445; open cars, electric, seven or eight benches, 582; open cars, electric, nine benches, 212; open cars, electric, ten benches, 47; mail cars, electric, 11; motor cars, electric, 2; horses, 857; electric motors, 2,108; snow plows, horse, 83; snow plows, electric, 115; snow sleds, 388; miscellaneous vehicles, 482.

A GAS ENGINE TROLLEY RAILWAY PLANT IN SWITZERLAND.

It is stated that the electric railroad at Lausanne is operated from a power house in which the dynamos are driven by two gas engines of 180 H. P. each, built by Crossley Brothers in England. They use a gas which is made in producers in the power house. The dynamos are run by belt. The working is said to be very economical, and the best result obtained has been an expenditure of 550 grams of anthracite coal per horse power hour in ordinary service. The engines are run on an average 18 to 20 hours per day. A careful calculation has shown that the amount of fuel used is 1,800 grams of anthracite per car-kilometer.

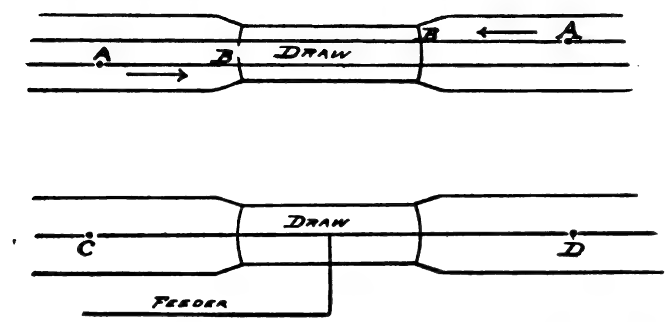
J. K. Tillotson, of Toledo, O., has closed a contract for the construction of fifteen miles of electric railway in Oshkosh, Wis., besides twenty-six miles of suburban line surrounding that place

PROTECTION AGAINST OPEN DRAWBRIDGES ON TROLLEY ROADS.

BY FRANCIS HEAD.

An inexpensive protection against accidents such as recently occurred at Cleveland, O., when a trolley car and a number of passengers went into an open draw is here shown.

Fig. 1 shows a drawbridge crossed by a double track, the letters A A representing section insulators in the trolley wire. When a car approaching the draw in the direction of the arrow passes the section insulators it takes current which has come across the draw. While the draw is open the lines between A and B will receive no current, and so, if the section insulators are



Figs. 1 and 2.—Automatic Cut-Out for Railway Circuits at Drawbridges.

placed suitable distances from the draw, automatic protection is afforded the car.

This arrangement has been in use since last spring on one of the bridges across the Schuylkill at Philadelphia, where the section insulators are placed several hundred feet from the draw.

Fig. 2 is an arrangement for a single track road where C and D are section insulators, and a feeder is used to supply the line between C and D.

TROLLEY FUNERALS IN CHICAGO.

Chicago managers of electric street railways are preparing to cater to funeral parties, as is already done in other cities. Sombre-colored cars will soon take the place of hearses, and the mourners will follow in trailers instead of carriages. The Calumet Railway Company has had a funeral car in process of construction. It is now ready to run funerals to Oakwoods cemetery. Funeral trains, with ordinary cars, have been in use on this line during the summer, but now arrangements have been made for the manufacture of a funeral car. The car above the tracks will be black. Even the trolley pole will be wound with crape. When the deceased is a child this crape will be white and the sides of the car will be festooned with white. Inside the car, just back of the motorman, a bier will occupy one side. Opposite this are to be seats for the minister and pallbearers. The mourners will sit along the sides of the car.

Funeral parties may charter a train with almost any number of cars, and start from any point on the line. A special motorman and conductor are uniformed in black.

WATER MEN FOR WATERBURY.

The Waterbury Traction Company has created much excitement among its employes by announcing its purpose to enforce the rule prohibiting motormen and conductors entering saloons at any time for any purpose. General Manager Sewell says it is his intention to have sober employees at any cost.

ANOTHER "PENNSY" BRANCH.

It is stated by the Philadelphia papers that the Pennsylvania Railroad now proposes to substitute electricity for steam on its Vincentown branch, a short line extending from Evansville on the Camden & Burlington to Vincentown. The distance is only three miles and current can be furnished from the Mount Holly power house.

A PROPOSED LONG-DISTANCE ELECTRIC RAILWAY IN FRANCE.

It has been decided to construct an electric local railway, about 60 kilometres long, between Besancon and Levier. The line will be on the overhead-conductor system, and have a gauge of 1 metre.

TROLLEY TRACK TAXATION.

The Winchester Avenue Trolley Company of New Haven, Conn., has appealed to the Superior Court from the vote of the City Councils to impose a tax of $700 a mile as a condition of permission to extend its tracks. The appeal raises almost every question relating to local trolley taxation in the state, emphasizing, however, the point that the state tax on the company excludes any local tax. Among other points raised is the important one that the city, as has been its custom, has no power to impose the condition that the company shall indemnify the city for damages connected with the operation of the railroad through its streets. The company contends that that matter is either already covered by the general statutes for damages, or, if not, no power is vested in the city to impose an indemnity clause. This case and the New Britain case will soon determine the whole question of the power of local trolley taxation in Connecticut, one decision by a Supreme Court Judge, sitting in the Superior Court, a lower tribunal, having already affirmed the local tax power.

THE BROOKLYN ELEVATED.

Chief Engineer O. F. Nichols, of the Brooklyn Elevated, has outlined the position of the company, as follows: "The company is considering no definite plan for electric equipment, nor is it considering any definite proposition from any electric company. After the World's Fair the Intramural Railroad Co. wanted us to use their electric equipment and since that time I have examined many other systems, but none of them is just what we want. If the change should be made it is altogether likely that the motors would be on each car, and we should not depend on engines, as we do now, but each car could move independently in either direction.

THE NEW OFFICIAL FENDER FOR BROOKLYN.

At a meeting of the Brooklyn Board of Aldermen recently Mayor Schieren presented the draft of a new fender ordinance in order to overcome the difficulties suggested in the recent decision by Justice Neu. The ordinance is as follows:

Section 1. On and after the first day of January, eighteen hundred and ninety-six, every car operated by electric power upon the surface railroads in the City of Brooklyn shall have attached thereto a fender in front of the front platform of said car, which shall be deemed to be the platform at the end of the car in the direction in which such car shall be traveling. Each of such fenders shall be not less than 5 feet in width and of such construction and so attached that it will project from a point (4 inches or thereabout from the dashboard and 6 inches or thereabout higher than the floor of said platform) outward not less than 4 feet and down to within 8 inches or thereabout of the rails, and the body of said fender shall consist of rope, wire, rubber, or other flexible netting. And that on and after that date no surface railroad company in the City of Brooklyn so operating its cars by electric power shall operate any of said cars upon any street or avenue in said city without a fender attached thereto in the manner and of the kind and character above provided.

Sec. 2. Any company operating any of its cars in violation of the provisions of this ordinance shall be subject to a penalty of one hundred dollars for each car so operated, for each day or part of day such car shall be operated.

The ordinance was referred to the Railroad Committee.

Alderman Cohn's motion that the Corporation Counsel be instructed to appeal from the decision of Justice Neu in the fender case was carried.

SAFETY DEVICES IN USE TO KEEP TROLLEY CARS OUT OF THE CHICAGO RIVER.

Chicago street-car men say that it would be an utter impossibility for an accident to occur in Chicago as appalling as the catastrophe at Cleveland recently. A cut-off device, simple but effective, is in operation at every draw which precludes the possibility of such an accident. August Hansen, assistant electrician of the North Chicago street railway company, explained the workings of the automatic cut-off.

He said: "Whenever the draw is opened even a foot, 600 feet of trolley wire on the right-hand track leading to the bridge is dead. The device which accomplishes this is very simple, but very effective. If it were left to the conductor to break the contact he might fail to do so, but with the device described there is no forgetting. It is simply an impossibility to run a car to the draw by the electric current when the bridge is open."

"CARS WITHOUT WHEELS."

The above is the caption that is now traveling around with an item on the Westinghouse "push button" railway system. The misconception is due to the fact that the inventor's name is Wheless!

"HUMANIZING AND EDUCATIONAL."

This is the way Mr. Charles Francis Adams, of Boston, characterizes the much maligned trolley; and he associates with it the bicycle as a beneficial agency.

A PREMIUM FOR GOOD WORK IN CAMDEN, N. J.

The Camden Horse Railroad Company has determined to offer extra inducements to its employees for faithful services, and $500 will be distributed among the motormen and conductors every three months. The conditions of the distribution are that those who during that time fail to have charges of any kind made against them shall participate. Any man who has a collision, is late to report, or is called to the front for any infringement of the rules, will not be in the distribution.

ST. LOUIS STREET CAR WORKS CONSOLIDATED.

Directors and stockholders of the St. Louis and American Car Works met on November 15, to close the consolidation deal. The new company will have one board of directors, and a capital of nearly $10,000,060. Both factories will continue to operate with the same superintendents. About 2,000 hands are given work.

AN AMERICAN ELECTRIC LAUNCH FOR THE CZAR.

Some time ago the Electric Launch Co. at Morris Heights, sold to the Grand Duke Alexander of Russia, an electric launch of the same type as that provided for the U. S. man-of-war "New York." The Czar of Russia has seen the boat, and being greatly pleased with it, has commissioned the Russian Embassy at Washington to buy for him another like it at a cost of about $4,000.

TRACTION FOR UPPER NEW YORK CITY.

The North End Street Railway Company of New York City has been incorporated with the Secretary of State with a capital of $5,000,000 to construct a street surface railway thirteen miles in length. The road is to have termini at the intersection of Manhattan avenue and One Hundred and Sixteenth street, and at Kingsbridge Road and the northerly line of the city, with branches extending from Eleventh avenue or the Boulevard and Broadway to the intersection of Broadway with Amsterdam or Tenth avenue, and from the intersection of Riverdale avenue and Kingsbridge Road to Riverdale avenue and the city line; and from One Hundred and Forty-fifth street and the Boulevard to One Hundred and Forty-fifth street and the Harlem River; and from Manhattan avenue and St. Nicholas avenue to St. Nicholas avenue and One Hundred and Twenty-sixth street. The directors are: Daniel H. Shea, Thomas J. Regan, Pierre Jay, Frank F. Ogston, and Wm. Shailler of New York City; Charles S. Sisson of Mount Vernon, and Edward K. Lynch, W. D. Davies, and Thomas E. Laughlin of Brooklyn.

STREET CAR MANNERS.

Is there any place, inquires the *Jamestown, N. Y., Sun*, where the selfishness of human nature shows itself more than in the electric cars? If there is, may I never find it. There is the man who stands on the back platform, and seems to take a fiendish delight in making you crowd past him. There's the woman who tells all about her personal affairs in a voice which fills the whole car. There's the small boy whose fond mamma lets him dig his elbows into his neighbors, wipe his muddy shoes off on anybody's gown—except her own—keep up a perpetual motion to everybody's discomfort and do other numerous disagreeable things. Actually one afternoon I saw a youngster who had made a nuisance of himself for 30 minutes amuse himself by spitting, not once but continuously on seats while father and mother sat placidly by. The most exasperating person of all, however, is the individual who, whatever the occasion, will not move. It is more often a woman than a man. A man, if he is not willing to submit to a little squeezing for the sake of the public good, will surrender his seat and retire to the platform, usually with good grace. Too many women will sit exactly in the middle of a space wide enough for two to sit comfortably, the only unoccupied space in the car—and never budge. Tired workingmen will come; she doesn't see them. Weary women, perhaps with little children, will look at her appealingly, and she gazes frigidly into space. If some more daring mortal than the rest tries to sit down, hoping that the gentle hint may be effectual, there follow a look, manner, sometimes a remark, which make the unlucky offender wish—well, over one's wishes at such times it is well to draw the golden veil of silence.

TROLLEY CAR "SITTING DOWN" STRAPS IN PITTSBURGH.

The Pittsburgh trolley cars have been provided with auxiliary seats which, when not in use, are held back by springs close to the longitudinal seats and serve as arm rests. When in use they are drawn down, and in cars seating twenty-two they afford fairly comfortable seats for ten on each side. The object is to provide seats in crowded cars where a closer schedule is not advisable.

MISCELLANEOUS.

PRACTICAL EXPERIENCE WITH STORAGE BATTERIES IN CENTRAL STATIONS.[1]

BY C. L. EDGAR.

To those interested in selling electricity, it is a source of great satisfaction that the storage battery discussion has, within the past few months, especially in America, taken on an entirely new phase. It has become a question of use and not of manufacture.

For years we have all watched with great interest the various types of batteries put upon the market. We have discussed their value, at first confining ourselves as to whether they would work at all, and in later years broadening out the discussion as to how well they would work. We have watched the various companies interested in the manufacture of storage batteries fight one another in the courts, and we have wondered if it were ever to be possible to obtain a battery which did not infringe some one else's patent.

Until very recently it has not been possible to discuss from the standpoint of experience the economic merits of storage batteries, and it is particularly satisfactory to us to note that the discussion seems to have drifted away from the manufacturer to the user. To-night I am going to assume, at least for the purpose of this communication, that these perplexing questions have all been answered, and that we are finally on a par with our neighbors across the water, prepared to discuss the advantages of a commercial storage battery found ready to our hand.

Whatever may be the facts as to the existence of a commercial battery, some of us have purchased and are operating batteries which we consider satisfactory, and I will leave that part of the discussion to others, confining myself exclusively to their uses in an Edison system of circulation and distribution for lighting and power purposes, in thickly settled communities. As it appears to me, their uses can be classed under four great heads, as follows:

1st. To carry the peak of the load at maximum hours.
2nd. To carry the entire load at minimum hours.
3rd. To act as an equalizer or reservoir.
4th. For the equipment of annex stations.

There are many other special uses for batteries which can be naturally classed under one of these heads.

First, to carry the peak of the load.—In all systems of lighting, whether by gas or by electricity, there is a considerable portion of the connected load which is used only for two hours per day during the three or four months in winter. We have all of us, at various times, very earnestly discussed the probability of being able to widen out this peak as it is commonly known, and numerous schemes have been devised by which it has been made more or less of a hardship for customers to use their light at this time, special concessions being made at all other hours of the day or night. It does not seem to me that any of these will avail. We cannot get around the fact that there are, in every large city, hundreds of stores which close up at six o'clock at night. The only need which they have for light is after it becomes dark. In this section of the country, darkness comes on about 4.30 in midwinter, and these stores are bound to burn their light from 4.30 to six o'clock, and have no need of it at any other time. These are facts which are entirely outside of the question of electric lighting, and nothing which we can do will change them.

It matters not whether the company has a large motor load in the daytime or a large city contract at night. These are simply going to change the height of the curve at those hours. They are not going to alter the special shape of the curve due to the hour and a half of darkness during the business day.

This particular peak will be in some cases a much larger percentage of the total maximum output of the station than in others, but I think it is safe to assume that it is likely to vary only between one-third and one-half of the total. In the case of the company with which I am connected, we have found that if we divide our maximum load of the year into two parts, the upper half exists only for about two hours under ordinary circumstances, and four hours under exceptional circumstances for the five winter months.

Computing the kilowatts in these two halves, we find that the lower half contains 90 per cent. of the K. W. hours manufactured, whereas the upper half contains only about 10 per cent. This would prove the position taken by some engineers that if an extremely large station was to be constructed, it would probably pay to equip it with two types of apparatus—50 per cent. to be of the best economy and most expensive class known to the art. This to do the 90 per cent. of the work. The other 50 per cent. to consist of crude, cheap, uneconomic but reliable apparatus, to do the 10 per cent. of the work. The saving in interest on the lesser investment in the second class would be much greater than the extra cost of running this half, due to its poor economy.

1. A communication read before the American Institute of Electrical Engineers, Nov. 20, 1895.

In our particular case we find ourselves in precisely this position. Our company installed in years past about 4,000 H. P. of high speed, belted, bipolar apparatus, reliable but of poor economy. Some three years ago it changed to the other extreme and commenced to equip with the highest priced and most economical apparatus to be found in the market, and to-day there is about 4,000 H. P. of this apparatus in use.

The data which we have for 1894 and 1895 proves the statement which I have just made. Ninety per cent. of our kilowatts have been manufactured by the vertical, triple expansion, multipolar units, and yet the total capacity of this apparatus is not over 50 per cent. of our maximum output for the winter.

The application of the storage battery to these conditions is obvious. What we need and what all companies under generally like circumstances need, is a piece of apparatus capable of doing two hours' work per day which is cheap, and which has fair economy. If storage batteries could be used under no other circumstances than these, it is, perhaps, somewhat doubtful whether it would pay to install them, but yet I am inclined to think that considering their first cost and the efficiency which we can obtain from them, it could be fairly proved that it would pay to use them rather than what I have designated as the cheap type of apparatus.

At the time our first battery was purchased, our standard unit was 650 H. P. We therefore called for a battery of 650 H. P. capacity for two hours. We eventually, under stress of circumstances, reduced this to one and a half hours and found that it cost considerably less than a first-class steam plant.

As all apparatus has to be installed for the express purpose of taking care of the maximum load, it seemed to us very clear that if we could save in our first investment by installing storage batteries which cost less than a steam plant, we were going to be able to do a given amount of work with a less amount of capital by this means than by any other. We thus decided to install a battery to take care of the peak, even if we obtained no other advantage from it.

Second, to carry the entire load at minimum hours.—I think that the nature of the load curve in America is against the use of batteries for this purpose to anything like the same extent as abroad. With us there is only about six hours of minimum load, whereas, owing to the lack of motor business in Europe, the minimum there extends some days from midnight until three o'clock in the afternoon. Our minimum is so short that we are not able to save one shift of men nor are we able to save much in the fixed boiler room expenses from drawing the fires, banking the boilers, or any of the various other expedients used when the plant is not in operation.

Our generating department has gone through some exhaustive experiments, running first the engines for 24 hours a day, charging the battery at minimum load, and then turning around the next week and shutting down the steam plant for the six hours from midnight until six o'clock in the morning, and depending entirely upon the battery. The general conclusion seems to have been arrived at that the former is the cheaper method. Admitting this, the indirect advantages of the former, by which the battery is charged during the night, and can be used during the following day, are very much greater than if the battery were discharged during the night, as it could not be completely charged again until the middle of the afternoon of the following day.

I do not consider our conclusions final, as the local conditions might materially change the result. In our case it happens that the output at night plus the charging current of the battery, is just equivalent to one of our standard units. If it were necessary to run two units to do this work, our conclusions might have been different, so that I think this is a case which has to be decided in each place on its own merits.

Third, to act as an equalizer or a reservoir.—It is this use of the battery with which we have been particularly pleased, and in order to understand, it is perhaps desirable to explain the needs which a modern station has for apparatus of this kind. Years ago a distribution company was equipped with one station, furnishing electricity through a system of feeders, supplied from one 'bus bar. All this is changed. To-day the modern station manufactures electricity in various places, transfers it from one station to the other at will, sends it out through a system of distribution at three or four pressures supplied from 'bus bars of varying potential. At the minimum hours of the day the electricity is manufactured by one set of dynamos, part of it being delivered to the 'bus bar in the station in which the dynamos are located, the remainder being sent out over tie lines to various annex stations and delivered there to the local 'bus bar. The amount of current is so small compared with the capacity of the various circuits that, practically, the pressure delivered at the lamps is constant, notwithstanding the various roundabout ways in which it reaches them.

As the load begins to increase, the drop over the tie lines becomes noticeable, and it is necessary, by means of auxiliary dynamos known as boosters, to raise the potential of that part of the output which is delivered to the tie lines.

The load still increasing, it is necessary to start additional dynamos. These may be thrown in multiple directly with the original pair and deliver the same potential as the others, or, if the condition of the load warrants it, they may be thrown in multiple with the original dynamos and the booster in series and deliver the potential needed by the tie line. In this case the booster might be taken out of circuit.

The load on the tie line again increasing, the booster would be again put in use and we would thus have the condition of a tie line supplied partly by a dynamo of the proper potential, and partly by additional current furnished by a booster, raising the potential from another 'bus bar supplying current locally.

This goes on until nearly the maximum load is reached. It then may be found, as it is sometimes in our case, that the original or main station is not equipped with sufficient dynamos to supply the local distribution. In this case the current over the tie line is reversed, and the annex station sends current to the original station, which arrives there at somewhat lower potential than is needed, and is there raised by means of a booster to the 'bus bar of that station. It is necessary to understand that these are everyday occurrences, and if we were not equipped with a battery, it would be almost an hourly question as to what it was necessary to do next, whether to start dynamos, stop them, change boosters or any other of the innumerable combinations which might be made. This trouble is intensified by the uncertainty as to what changes are going to take place in the output, and what the load is going to be at any given time. In a very large degree the battery answers all these questions or at least makes them unimportant. It makes it possible to determine beforehand what the regular day's work of the steam plant is to be, to decide how many and at what time boilers are to be put in service, when engines are to be started or stopped, and in general to operate the plant to its best economy, knowing that daily or hourly inequalities in the load, or uncertainties caused by the weather will be taken care of by the battery.

It is kept in multiple with one or the other or all 'buses at all times. It is supposed, for many hours of the day, to be standing idle with the ampere meter at zero, but it may, without a moment's warning, be called upon to either give or take anywhere from one to 3,000 amperes on a side. It is possible in this way theoretically to keep every engine which is running loaded up to its maximum economy at all times. Practically we have found it possible to never operate an engine with less than three-quarters load. The economy of the steam plant then more nearly approximates what is known as mill practice, which is the goal toward which we are all striving.

Having satisfied ourselves in the beginning that with a given amount of capital we could do more work with the battery than without it, we by actual practice came to the conclusion that we could by the same means do this same amount of work more cheaply. When we remember that we installed the battery for the express purpose of taking care of the maximum load, we are, of course, particularly pleased at the very great use we can make of it for this purpose of equalization, and yet, in addition to this, we have made enough tests to prove to our own satisfaction that we do not lose anything in fuel economy by this particular use of the battery. The watts lost by the inefficiency of the battery are made up more than fourfold by the better economy of the steam plant. We have taken typical winter days and figured out exactly the cost of running our system with the battery and without, and have proved that the actual coal consumed with the battery is a material amount less than without it. If, in addition to the fuel, we take into account the very great saving in the labor, the added reliability and the better service given, we will see that these uses of the battery are even greater than those for which it was originally installed.

I do not think it is possible to overestimate the advantages of storage batteries for the purpose of giving regularity and reliability to a system of distribution. With very sudden fluctuations in the load which are continually taking place, it is almost impossible with dynamos alone to regulate the 'bus pressure so quickly that the pressure throughout the system remains constant. Of course, we have done this for years to the best of our ability, but it has necessitated keeping everything in first-class shape and having the employees of the company on the alert at all times to take care of this question. The uses of the battery very much simplify this problem. Very many times where in the past it was necessary to change the magnetism of the fields of dynamos, it is now necessary to do absolutely nothing, the battery acting as a reservoir, giving out quantities of current without any apparent change in pressure for the time being.

This question of regularity is very closely connected with the one of reliability. To those of us who are identified with central station work, there is a great sense of security when we realize that whatever may happen to the steam plant, we have sufficient battery to carry us over a few minutes of disorder. In our particular case, we have at the present time sufficient battery to run 60,000 lamps for five, ten or fifteen minutes, depending upon how great is the emergency. This advantage of the battery may not appeal to an outsider. I do not think they can realize the intense nervous strain to which all connected with the successful detail operation of the station are subjected. If a battery and a

steam plant were on a par in all other respects than this, I should personally feel very much inclined to install it for this reason alone.

4. *For the equipment of annex stations.*—This is a use to which we have looked forward with great interest, but up to the present time have had no occasion to make the use. There are in every city certain sections, located so far from the centres of distribution that it becomes a very serious and expensive matter to reach them with the regular three wire system.

When we realize that it makes very little difference to which end of a tie line a storage battery is connected, we can see at once the special advantage which this type of apparatus gives us. If of such value that it will pay to install them, it is a matter more or less immaterial whether they are installed at the main station, or at an annex station connected to the main station by tie lines.

The fixed charges of running a battery room are very small as compared with those of a steam station, and there would not be any very material increase of fixed expense between one large battery located in a central point and half-a-dozen small ones distributed throughout the city.

Storage batteries, therefore, lend themselves particularly to the location of a "central" station at some convenient point upon the water front, and the building up of small centres of distribution scattered throughout the city, consisting of storage batteries with or without a steam adjunct and connected together possibly, but certainly each one connected to the central station.

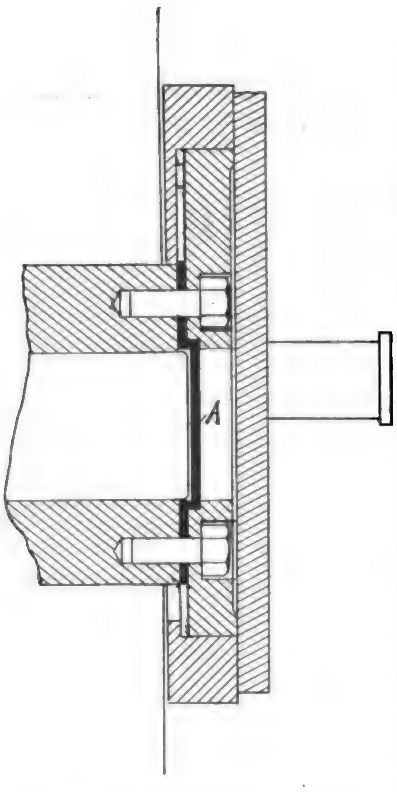
This communication may be considered to have been written upon very narrow lines and I may say that this was intentional. So much has been written during the past few months upon generalities and upon possible cases which may or may not exist, that it is sometimes valuable to brush these all on one side and to confine oneself to some specific cases. This I have tried to do.

Our company has used the first battery 20 months, and one of double its capacity for six months, entirely too short a time to come to any conclusions about the depreciation, but it has given us ample time to satisfy ourselves as to the economic value. It is sufficient for me to say that if a need should arise to-morrow for additional capacity, either at our main station, at either of the annexes or in any new part of the city, within reasonable distance of our centre of distribution, we should consider the question along the lines which I have just indicated. We should eliminate entirely from the discussion, the question which has distracted the public mind for so many years, and decide it entirely upon its merits, placing the battery side by side, and on an equality, with other modern and improved apparatus.

CURRENT ELECTRICAL SCIENCE.

Prof. Cardani, of Parma University, contributes an important paper to the *Nuovo Cimento* dealing with the RESISTANCE OF CIRCUITS TO ALTERNATING CURRENTS. The work begun by Dr. Lodge and Lord Kelvin is carefully elaborated, and the results appear to admit of no doubt. Resistances were measured by the heating effects, as was done by Klemencic. The wires were surrounded by a tube containing petroleum, and communicating with a capillary "thermometer tube." The heat developed in the wire expanded the petroleum, and the rise of the petroleum in the capillary tube indicated the amount of heat and the temperature. An influence machine was discharged through a divided circuit, consisting of two such wires with thermometers. In this manner various wires were tested for resistance to alternating discharges. The law of diameters seems to be a very complicated one. For copper and brass there was a certain diameter, for which the resistance was a maximum. Platinum is the best conductor at larger diameters, but when it becomes very thin the resistance increases enormously. As regards the vexed question of the comparative resistances of iron and copper, Prof. Cardani finds that at larger diameters they are equal, but that thin iron has a lesser resistance than thin copper. Another Paper of some interest is one by A. Garbasso, on the double refraction of RAYS OF ELECTRIC FORCE. This was observed with Righi's tinfoil strip apparatus. Double refraction effects were obtained with calcite, Iceland spar, felspar and mica.—In the *Journal de Physique* for October, MM. Abraham and Lemoine describe an attracted disc electrometer for very high potentials, say 100,000 volts. The commercial type is constructed on the principle of Roberval's balance, and is claimed to measure within 1 per cent. A curious feature about this instrument is the primitive manner in which the guard ring is brought into position, viz., by bending the S-shaped soft-copper wires by which it is suspended. Accurate results are obtained so long as the distance between the plates does not exceed half the width of the guard ring. *Apropos* of Cardani's assertion that the resistance of some wires increases with their diameter, we have in the *Journal de Physique* the equally startling announcement that the resistance of a spark is greater the smaller the gap. This is explained on the hypothesis of a counter E.M.F. due to a detaching of particles by the short violet sparks. The strong white sparks offer less resistance. If anybody doubts this let him try the experiment.—*London Elecn.*

A MICANITE CAP SAVED IT.



NOT long since we gave an account of a case of erratic governing of an engine direct connected to a dynamo. The engine, it seems, was erected and ran well for a few days, and then suddenly failed to regulate properly. Some inherent defect in the governor being supposed to be the cause of the trouble, a new governor mechanism was substituted and the trouble ceased, only to be renewed after the lapse of a few days.

It was then suspected that the fault might be due to stray magnetism from the dynamo affecting the free motion of the governor parts, and a test showed these parts to be highly magnetized. After trying several expedients to remedy the evil, the following was adopted, illustrated in the accompanying sketch. A cap of micanite A was placed between the eccentric and the hub of the wheel to which the eccentric is fastened, phosphor bronze studs being used for fastening the parts together. This construction afforded complete magnetic insulation and prevented the sticking between the working surfaces of the eccentric, and other parts of the governor mechanism. Since the application of the micanite cap no difficulty whatever has been experienced in the operation of the engine at all loads.

PLANS OF THE NATIONAL ELECTRICAL EXPOSITION CO.

The National Electrical Exposition Company has been incorporated for the purpose of holding an electrical exhibition in May next under the auspices of and in connection with the Nineteenth Convention of the National Electric Light Association. The officers of this company are Harrison J. Smith (Superintendent of the Edison Illuminating Company of New York), President; Wm. F. Weiss (Vice-president of New York Steam Company), Vice-president; George F. Porter, Secretary and Treasurer. The executive committee, which is the governing power of the company, is composed of H. J. Smith, C. O. Baker, Jr., R. B. Corey, H. L. Lufkin, E. F. Peck. The board of Directors consists of H. J. Smith, C. O. Baker, Jr., John A. Seely, R. B. Corey, W. A. Stadelman, H. H. Harrison, H. L. Lufkin, W. F. Weiss, J. W. Godfrey and E. F. Peck. The stock has all been subscribed for and ten per cent. of its capital paid into the hands of the treasurer.

The New York Industrial Building has been secured for the exhibition hall. This building occupies the block bounded by 43rd and 44th streets, Lexington Avenue and Depew Place. The building was constructed expressly for trade exhibitions. It has seven stories with roof garden, is lighted from a plant of 5,000 incandescent lights and has spare steam plant of 800 H. P. The lighting companies of New York can supply direct or alternating current to any amount desired, and two gas companies can furnish gas through two four inch mains. The company is now prepared to receive applications for space.

All communications should be addressed to the executive office of the company, 136 Liberty Street, New York. Several large applications for space have already been filed.

ELECTROLYTIC MINING IN MONTANA.

The Boston & Montana Company recently made experiments with its electrolytic plant at Great Falls, and demonstrated that with increased power the plant could be doubled without increasing the vats or extending the buildings. The entire electric power used by the electrolytic plant was turned upon one-quarter of the operating plant, and its efficiency increased four fold. This demonstration being complete, the Boston & Montana has contracted with the Westinghouse Electric & Manufacturing Company for two 1200-horse power generators, costing $25,000 each. They

should be in working operation by spring. Then all the Boston & Montana product will be electrolytic. The Boston & Montana output is now sold up to the middle of January. Nothing has been sold in this country, it is said, on less than a basis of 11c. for electrolytic.

PAST AND PRESENT OBSTACLES IN THE STORAGE BATTERY DEVELOPMENT.[1]

BY CARL HERING.

The great and numerous advantages of a satisfactory electric storage battery have been described so often and are so well recognized and admitted by the unbiased that it seems unnecessary to again enumerate and discuss them here. The question which the engineer and constructor should discuss at present is not, "Is a battery desirable?" but rather, "Why is it that storage batteries seem to have been unsatisfactory?" and the question which concerns the capitalist is "Does it pay in dollars and cents to use the storage battery even if it is kept in a satisfactory condition by the makers?"

The latter question can be disposed of here in a few words. If the makers guarantee to keep the battery in a satisfactory condition for a certain rate per annum, or if they rent them, then it becomes a mere matter of calculation to find whether it pays or not; but this calculation must be made for each specific case, as the cost of the batteries and their maintenance seem at present to be such that an estimate for a general case can hardly be considered conclusive, the margin being in many cases too small. In some specific cases it will be found to be decidedly cheaper, in some it will be doubtful, and in some, decidedly too expensive. Limiting ourselves to this country and judging in a general way from the number of storage battery installations, it would seem that the price at present (including of course the cost of maintenance) is such that in perhaps the majority of cases the margin of profit to the user is so small or so doubtful that it does not balance the supposed risk. The commendable practice of renting, relieves the purchaser of this risk, which then leaves the question a mere matter of cost. A material reduction in the first cost and cost of maintenance would, therefore, at once turn the tables in many cases so decidedly in favor of the storage battery, that there would be little doubt left as to the economy and it would render the practice of renting unnecessary in most cases. Cheapness, therefore, is one of the most important points which affect the outlook of the storage battery.

To return to the first question, "Why is it that storage batteries seem to have been unsatisfactory," we must limit ourselves to this country, as probably thousands of tons are and have been in successful use abroad. In Germany, for instance, almost every one of the large continuous current central stations is equipped with a battery plant; in England they are used very largely for private plants, as also for central stations; an English firm recently claimed to have sold a total of "six miles" of accumulators placed in one continuous row, and a French firm is stated to make several tons a day.

The chief reason why so few storage battery plants exist in this country, seems to have been that the accumulator companies have for years been so busy fighting each other's patents and have spent so much money in this litigation, that they have had neither time nor money left to manufacture and install their batteries. But all this litigation has now come to an end, thanks to an enterprising company which has bought up all the little life that is left of these historic "pasted plate" patents. This, together with the fact that it is now conceded by many authorities that for many if not most purposes the unpatented Planté type of cell is the better, removes the chief obstacle in the storage battery development in this country. The fact that the companies have been too busy with litigation to attend to legitimate business, has shaken the confidence of the public who naturally ask "Where are your batteries in use," the only unsatisfactory answer to which is "Abroad." Much "missionary work" must first be done before public confidence will be restored and let us hope that the recently started "rental" companies will soon accomplish this. It is up-hill work, but prospects at present seem bright and encouraging.

As the patent question has now been settled and as cells of the Planté type have now been developed into practical forms, the storage battery outlook at present lies largely in the hands of the constructing engineer, and we should therefore look at the question from this standpoint.

The storage battery has for years had the reputation of being like a delicate, sickly baby, continually threatened with half a dozen diseases, and requiring the constant attendance of a trained nurse, besides the fatherly care and large purse of its manufacturer. To the user the five chief diseases of the accumulators appear to be: buckling, short circuiting, sulphating, disintegration and dropping out of the peroxide. Many inventors have thought that most of these may be made uninjurious by a process of opposing or resisting their disastrous effects, as distinguished from preventing their occurrence, although the term "preventing" has incorrectly been used to describe it. Buckling has been opposed by main strength and sometimes awkwardness, short circuiting by porous insulating sheets between the plates, falling out, by enclosing or locking the peroxide so that it cannot drop out, etc. Whether and how far such heroic methods have been successful can be determined only by tests, but it seems to the writer that many of the methods are like curing corns by cutting off one's feet, the cures may be effective, but can hardly be called satisfactory. To attempt to prevent the almost irresistible force of expansion of the peroxide from exercising itself by confining the material in an inelastic lead frame, is a formidable and it seems, an almost hopeless task; the inevitable result is that one or the other must give way; if it is the peroxide, it will ultimately be crumbled by the pressure; if it is the lead, there will probably be buckling or at least a separating of the contact surfaces at the subsequent contraction of the peroxide, and this inevitably results in the formation of that very objectionable layer of white sulphate which practically insulates the active material from its conductor, the consequences of which are sure to be fatal. The development of the storage battery has been greatly retarded by the fact that it was in the hands of mechanical engineers instead of chemists.

The careful constructor should attack the problem in a different way; he should go back to the beginning to find out the prime causes, and then prevent, if possible, these causes from arising, rather than to attempt to oppose their effect by sheer force and awkwardness. These causes seem now to be understood, and the question therefore is how to prevent them. One way is to supply with each battery a printed and neatly framed long list of "dont's" or limitations in the form of rules telling you what you must not do, with a foot note attached, saying, that the company's guarantee ceases if these rules are violated. This may be satisfactory to the company but certainly not the user. A more satisfactory way would be to construct the plates, if possible, so that these prime causes of trouble cannot arise, no matter what mistakes the attendant may make or what emergencies the battery may be called upon to meet—within reasonable limits of course. To discuss all these prime causes in detail would require writing a treatise on the subject, but they may be summarized briefly and their prevention will then suggest itself.

The chief evil effects are apparently caused by too rapid charging and discharging. With many of the favorite methods of avoiding the effects of high rates, the capacity and efficiency at such rates both become so low that the user will be discouraged from discharging so fast, and the current will fall so rapidly that it will have little chance to do much mischief. Such methods are applicable only when rapid rates are never desired, but those cases are the exception, rapid rates, or at least a provision for them, being generally very desirable and often essential as in traction work for instance; such methods have therefore solved this problem only for a limited field. What should be done is to try to construct the plates so that they are adapted to high rates without a great loss of efficiency or capacity. It will be found that in the majority of cases in which the storage battery would be of special value, it is a question of *rate* rather than *capacity*, that is, a great horse power for a short time is more often required than a large quantity of energy delivered at a slow rate; it seems from a number of cases, about which the writer has recently been consulted, that any capacity above that which is obtained at a one, two or three hour discharge is generally of comparatively little value.

To study the effects of rapid discharges it must be remembered that the acid is as important as the lead oxides; when its density falls too low there will be a lowering of the E. M. F.; acid is withdrawn from the solution during discharge, hence the diluted acid in the fine pores of the active material must get out and denser acid must get in; but the only force which does this is the difference between their specific gravities, and as this is very small, the force will be small and therefore the circulation will be slow, which in turn reduces the E. M. F. The chemical action will therefore be confined chiefly to the external surface, which is freely exposed to the acid and the action then becomes so great per unit of surface, that white sulphating, or better, complete sulphating, takes place. If a rapid discharge is not to injure the plates nor lower the voltage by reason of the acid in the pores becoming too dilute, the circulation must be rapid; great porosity accomplishes this partly, but is attended by frailty and poor conductivity of the peroxide, which again results in a fall of the voltage. The ideal method would, therefore, seem to be a vertical lead plate to act as a good conductor with an extremely large surface and a very thin layer of peroxide on it, freely exposed to a large quantity of acid, which is capable of circulating rapidly. That such a plate may be made to have a greater capacity per pound of plate for rapid discharges and perhaps an equal one for slow discharges, as compared with the best thick, porous plates, has been shown by experiments. The great capacity is doubtless due to the fact that the active material is more completely utilized, as it is all close to the conductor and freely exposed to the acid. The capacity of such a plate will evidently be affected only slightly by the rate, and the loss of voltage and therefore the watt efficiency will depend more on the conductivity of the lead, than on the acid becoming too

1. Communicated to the Amer. Inst. Elec. Engrs., at the meeting held Nov. 20, 1895.

dilute in the immediate neighborhood of the active material. To obtain high rates accompanied by good efficiency and capacity, there is little doubt that the best way is to use large freely exposed surfaces, rather than to try to resist the evil effects of high rates, mechanically.

In rapid charging the acid becomes too dense in the pores of a thick mass of active material if the circulation does not keep pace with the demand; this dense acid softens the peroxide and there is a tendency to form gases when the proper chemical action cannot keep pace with the current. Both the softening of the peroxide and the mechanical effects of the gases are injurious. What was said regarding porosity and the ideal plate applies therefore also to the charging.

The negative plates being soft and tough, are not so easily injured, but unless the acid can circulate very freely there will still be a lowering of the voltage as with the positive plates, and probably also a lowering of the ampere-hour capacity.

The contact between the peroxide and its conductor must be very good, for, if poor, then a white sulphate forms at the surface, which practically produces an insulating layer and disastrous effects are then inevitable. The ideal contact is obtained when the peroxide is formed on the lead electrolytically, as in the Planté processes.

The peroxide will insist on expanding during the discharge and on contracting during the charge. It would be much better to accept this as an inevitable fact than to try to keep the material from obeying the laws of nature by forcibly confining it within an inelastic frame, as many inventors have attempted to do; the results of such an attempt have already been described. To hold a large mass of active material firmly in contact with a lead conductor, when one expands and contracts while the other does not, or expands without afterwards contracting again—is a difficult matter. The best solution seems to be, to have the active material in the form of an extremely thin layer over a large surface and formed from the lead itself, as this increases its adhering properties. If such a layer can be made porous and if the surface is made up of small facets, there will be little tendency to buckling or scaling.

The gradual washing away of the surface of the peroxide, and the slow peroxidation and consequent disintegration of the lead support, seem to be absolutely unavoidable. Until some preventative is found, if it ever will be, it seems wisest to accept the inevitable and acknowledge that the positive plates are perishable. To use any other metals or carbon, is out of the question; the addition of antimony to the lead seems to retard but does not prevent peroxidation. The favorite method of trying to avoid the effects of disintegration is to make the frames of the positive plates quite thick, thus prolonging their life. This, if not accompanied by other disadvantages, may be satisfactory for stationary plants in which the great additional weight is no hindrance, the only objection to it being the cost of the metal, which is no small factor in the total cost of the plate. But such a method is certainly not satisfactory for cheap or portable cells, and the gradual washing away of the peroxide remains the same whether the frame is heavy or light, provided that the surface exposed to the liquid is the same.

But there is another way of meeting those unavoidable effects of use, which has recently been applied, and which seems to be a much more rational and effective solution of this vexed problem, at least when lightness and smaller first cost are desired. Instead of making the positive plates heavy and expensive, they may be made very light, cheap and easily replacable; their life may then be shorter. but the battery will be as good as new whenever these perishable parts have been renewed; their life is soon known to the user and he can then readily determine for himself how much he must allow for amortization. Anyone who has urged the use of accumulators will appreciate the great value of being able to satisfy the user as to the amortization factor. A purchaser will believe you if you admit that the life of the perishable parts will be comparatively short, but he will not believe you if you say it will be long, even if you are telling the truth. But such a method, to be successful, requires that the old plates and sludge can be converted at a small cost into new plates; this it seems can now be done and the writer believes that this alone will have a very important bearing on the outlook of the storage battery, at least for portable cells that are required for traction and many other purposes, or for both portable and stationary plants if the first cost is an important factor. Such a method becomes practicable only when the chief factor in the cost of the plate is the material, the cost of labor and forming being small.

For stationary purposes, in which the only objection to the weight is the first cost of the lead, good storage batteries have been used abroad with success for some time, provided the rates of charge and discharge are kept low. Assuming that the same storage batteries may be made in this country as well, the question which affects the outlook here is then only one of the cost. But neither abroad nor here does there seem to be a battery in the market in which the weight has been sufficiently reduced and the rate sufficiently increased for a really successful traction battery, the success of which has been demonstrated beyond dispute. It is here assumed that to the public and to railway companies, traction batteries are not a demonstrated success until a traction company which has no affiliation with the accumulator makers, finds it to its own advantage to use them in preference to other systems. That accumulator traction is the ideal system has been repeatedly acknowledged by good authorities, and that this field for batteries is very large and perhaps larger than that for stationary work, is likely. The large first cost and cost of maintenance of the overhead construction for trolley roads, the large power station required, and the threatened damages done by electrolysis, would doubtless turn the tables in favor of the storage battery for many long roads on which traffic is not too dense, and possibly also for many suburban steam roads.

It seems to the writer that the only batteries which have a promising outlook for this very trying work, are those which have a very large surface, very small depth of active material formed electrolytically, and a very free circulation of the acid. The lead frames should be made only thick enough for proper conduction, the batteries must be cheap in first cost, and the positive plates should be capable of being replaced comparatively frequently at small cost. They should be proportioned so that a discharge corresponds to one trip of the car—and only one. To claim as an advantage that a battery can run a car, say four trips, is mere deception, and to the intelligent engineer it is simply an admission that it can do no better. No one would think of carrying four relays of horses on a trailer of a horse car, and why should the equivalent be done with the storage battery unless it is that the battery can do no better and that it cannot be discharged rapidly enough so that the capacity and weight may be reduced to that required to run only one trip. The ideal is certainly a single trip discharge. If the rate for a four-trip battery could be increased four times without materially affecting the capacity, its weight and capacity for a single trip discharge would evidently need be only one-fourth as great. The charging rate should also be equal in hours to the discharge rate, or else it will take a plant of more than two sets of batteries to a car.

These various ideals mentioned above would have only a theoretical and not a practical interest, were it not for the fact that recent tests have shown that a near approach to them has apparently been reached; it is somewhat premature at present to say more until the results of the tests have been confirmed by practice.

The above discussion may be briefly summarized as follows: cessation of litigation and the development of the Planté type of cells, make the storage battery outlook in this country much brighter; the cost of a guaranteed storage battery seems in many cases to be too nearly equal to that of the direct generators to encourage their general adoption. A reduction in the cost would therefore open a large field, much larger than in proportion to the reduction; the renting of accumulators seems a commendable method for introducing them. Most of the diseases which storage batteries are subject to could be avoided or made much less disastrous by having large surfaces, small depths of active material and free circulation. The first cost would be reduced and the vexing question of the uncertain amortization, settled, by a light, short-lived, cheap positive plate and a cheap process of re-converting old into new positive plates. Storage batteries for slow discharges have been a success abroad; a very large additional field would be opened by a light, cheap, rapid-rate cell.

The objection to a plate with a thin layer of active material, is that it may not retain its charge as well as one with a thick layer or pellets, but in most cases in which rapid rates are desired or cannot be avoided, the small loss in standing is probably more than balanced by the fact that the plates are not injured by rapid rates. As a rule, long periods between charges go hand in hand with slow discharges and less objection to great weight, while short periods between charges, high rates of discharges and lightness, usually go together.

In conclusion the writer desires to take this opportunity to make the following recommendations in the interests of engineers who may have to calculate accumulator plants:

That rates of charge and discharge be designated in *hours* and fractions, the current (or for power purposes, the watts,) during that time being considered to be kept constant. There can then be no mistake as to what is meant, as this represents the time in hours during which a cell will continue to give a practically constant current before the voltage falls below its limit.

That efficiencies and capacities be always accompanied by the corresponding rate in hours.

That in giving an efficiency it should always be stated whether it is for ampere hours or for watt-hours.

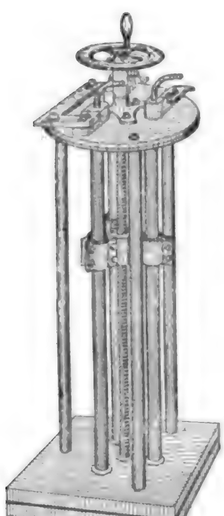
That for portable batteries intended for power purposes, the capacity be given in watt-hours instead of ampere-hours and that the weight given be that of the complete cell ready for use, as distinguished from the weight of the plates alone.

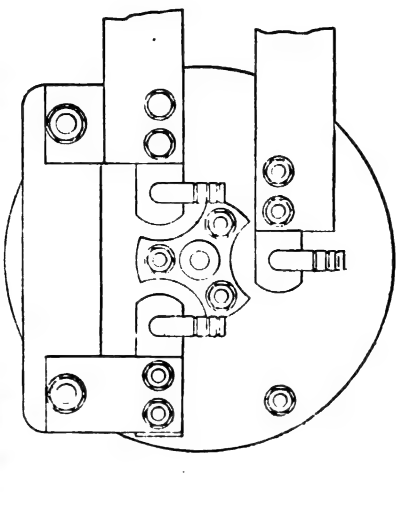
ELECTRICITY IN THE RUSSIAN ARMY.

Russia is to have an electrical branch of her army under the direction of a Lieutenant-General, two Major-Generals and five officers of lower grade; who will also have a military electrical school under their charge. Russian military officers have always been very adept in the use of electricity.

WATER TUBE RESISTANCES.[1]

Resistances, whether intended to be used "rheostatically," to reduce the current in a given circuit, or on the C^2R principle, to absorb power, have, in common with most other heavy electrical apparatus, undergone of late a very rapid process of evolution. In Fig. 1 we give a perspective view of a lineal descendant of that old and well-tried telegraph organism, the rheostat. The illustration shows a regulating resistance made by Mr. Crompton to Major Cardew's and Mr. Rennie's design, for use in connection with the





FIGS. 1 AND 2.—WATER TUBE RESISTANCE.

grand army of Kelvin balances quartered at the Board of Trade Standardizing Laboratory. The overall dimensions of the apparatus are 8 ft. 6 in. high by 15 in. x 15 in., and its range is from 60 up to 5,000 amperes. It consists of three resistance tubes, 1 metre long, 35mm. in diameter, and 0.5mm. thick, two being of manganin (0.004 ohm) and one of copper. Through each current-carrying tube water is passed from bottom to top, carrying away the heat generated by the current, the density of which sometimes attains 30,000 amperes per square inch. These three tubes, as will be seen by the sketch, are arranged triangularly around the centre

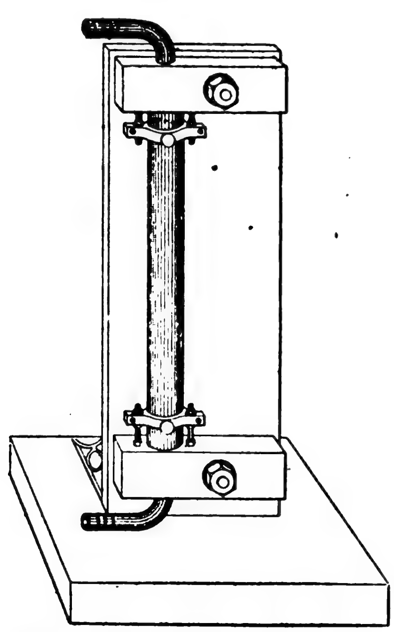


FIG. 3.—WATER TUBE RESISTANCE.

of the base. The three outer tubes are supports, and do not carry current. The current-carrying tubes are connected across by a travelling brush, adjustable by means of a screw and wheel. In Fig. 2 we give a plan of the top connections of the apparatus, as arranged at the Board of Trade Laboratory for regulating the current through the Kelvin balance circuit, the water-tube resistance being placed in series with the circuit containing the balances. The manganin tubes are placed in parallel with each other and in series with the copper tube. The whole apparatus has been well thought out, and presents a very workmanlike appearance.

Mr. Crompton is also making, for anyone requiring them, a number of *standard* water tube manganin resistances. In Fig. 3 we give a perspective view of such a standard, shown us by Mr. Crompton's able assistant, Mr. W. C. Fisher; its resistance is a thousandth of an ohm, and it has therefore, with a current of 1,500 amperes, a potential difference of 1.5 volt between its terminals, the overall dimensions being base 11 in. by 11 in. and height 18 in. In connection with potentiometer measurements of current a handy standard resistance of this type should prove invaluable. The water used in carrying off the heat generated by a current density of 15,000 to 20,000 amperes per square inch is obtained from the ordinary supply by means of a small rubber hose pipe.

1. London *Electrician*.

REPORTS OF COMPANIES.

A COMPANY TO UTILIZE THE TRENTON FALLS, N. Y.

A Philadelphia dispatch says: "It is announced that the entire issue of Empire State Light, Heat and Power Company fifty-year 5 per cent. consolidated mortgage gold bonds have been taken. The issue amounts to $3,000,000, of which $1,000,000 is to be held in escrow to retire underlying liens. Of the $2,000,000 to be sold $1,000,000 goes to New York, $500,000 to Boston and $500,000 to Philadelphia. It is believed that the issue will be over-subscribed; each subscriber to a $1,000 bond will receive $750, or 7½ shares of full paid stock. The company will control by purchase the street railway and electric light companies in Utica, Whitestown (N. Y.) mills and New Hartford, N. Y., and will have an electric plant of 20,000 horse power capacity, the power to be received from Trenton Falls, N. Y."

GENERAL ELECTRIC BUSINESS.

The Boston *News Bureau* prints the following: The General Electric people expect that the company will show for the present fiscal year about 3 per cent. earned upon the common capital shares. The cash on hand is, as it has been for some time past, about $500,000, and the company has besides its Dec. 1 bond interest of about $250,000, which it has had in a special deposit at the Trust Co., since last June.

As the company is now doing business upon a cash basis the only explanation which is given as to why the company's cash does not increase faster is that the expansion of business has required an increased investment in tools, machinery and raw materials. The company has made all this and continued its business upon a cash basis, although it has not paid or redeemed any more of its 5 per cent bonds since the directors' last announcement.

OBITUARY.

A. J. TINSLEY.

A. J. Tinsley, manager of the Western Union Telegraph office at Gainesville, Tex., and one of the oldest citizens there died on Nov. 18, of paralysis. He was second chief engineer of the Confederate warship "Merrimac" and was one of the few survivors of that vessel's memorable battle with the "Monitor." He was buried with Masonic honors.

PERSONAL.

MR. R. L. GALE has been appointed assistant general manager of the Water, Light & Power Co. of St. Cloud, Minn.

MR. A. M. WILLCOX, of the *Railway World*, has an interesting communication in a recent *Pall Mall Gazette* on the desirability and feasibility of the trolley system for London.

MAJOR G. B. EDWARDS, of Charleston, S. C., has been appointed receiver of the Charleston Light and Power Co. He has for some years past been its president.

MR. A. C. MCNEELEY, who has for a long while been in the employ of the Chattanooga Telephone Exchange as electrician, has gone into business for himself, and will take electrical contracts himself in the future.

Society and Club Notes.

THE BOSTON "ELECTRIC POTENTIALS" AND UNDERGROUND WIRES.

The "Electric Potentials" of Boston celebrated the opening of their winter season by a dinner at Young's on Nov. 25, when Capt. Wm. Brophy, Asst. Commissioner of Wires under the Boston City Council, read a valuable paper on the subject of "Underground Wires." The officers of the body are Frank Ridlon, president; Sidney Hosmer, secretary; I. H. Farnham, treasurer. The occasion was graced by the presence of members of the West End Railroad, Boston City Council and other public and private officials. The proceedings after dinner were begun by a pithy and graceful speech from the president, who was followed by Mr. F. M. Kimball, who spoke as a connecting link between the old electric club and the present organization. Capt. Brophy's paper is printed elsewhere in this issue (see page 542).

Col. Raymond, treasurer of the Cambridge Electric Light Co., spoke briefly of the tendency of late to jeopardize the electrical industry by public agitation and the interference of the State Legislators. He was of opinion that the private corporations had made Massachusetts what it now is as a rich manufacturing State. Ill-advised attempts were constantly being made to interfere with the rights of private investors, which were nothing short of a policy of confiscation and wrong. He was a little fearful of the future, and yet he was hopeful that things would right themselves in time.

Mr Sengraut, of the West End R. R., said that his opinion was that the railway trolley wire was about as safe as any electrical wire now in use. At the same time he hoped the time would soon come when the trolley wires would disappear altogether.

Mr. I. H. Farnham, electrician of the New England Telephone Co., in alluding to the insulation of wires, said that his company had a fixed point which the insulation on all their cables must reach or they would be rejected. Perfect insulation was most desirable and all telephone companies would welcome a thoroughly perfect insulation.

The abrasion of insulation was a serious matter, and they had been compelled to adopt a special kind of wire which had a spiral covering of iron that resisted any amount of chafing. To adopt such a wire universally, however, would be so expensive that it might be cheaper to place all wires underground.

Mr. G. W. Blodgett then suggested that Captain Brophy give them the benefit of his knowledge of some experiments recently made with bare copper wires in a conduit at Niagara.

Captain Brophy in reply said that so far that wire had acted very satisfactorily, but he would not endorse it until it had been tried through the coming winter.

Mr. J. W. Denver, of the New England Telephone Co., said that insulation was too often a delusion and a snare. He was inclined to say that it would be best to let all overhead electric light wires be bare. People would avoid them and keep away from danger. As a telephone man he said that they always had and might always have to encounter difficulties and trouble from high potential electric light currents. It behooved all lighting companies, for the present, to adopt the best insulation possible, for their own interests at any rate. By so doing they might save a dividend which is too often pumped into the earth owing to leakages.

Mr. Coughlin, of Worcester, said that in his city they had laid some 300,000 feet of underground ducts, but they were not likely to run the wires in those ducts before next spring. They were inclined to wait and see how the underground wires in Boston acted during the approaching winter. They had not thus far encountered many difficulties from electric light wires, yet he was decidedly of opinion that sooner or later wires in all cities would have to go underground.

Mr. G. W. Adams, of the Boston Electric Protective Association, declared he had never had trouble from electric light wires.

Mr. H. S. Anderson, of Springfield, had a good deal of interest in high potential wires. In the city he was from they placed in 1887 a 1000 volt circuit underground and though during a blizzard in the following spring the circuit was completely spoiled, which necessitated its being taking up, yet notwithstanding that mishap they had to place their circuits underground again, and of late they found no difficulty.

Mr. J. R. Orford, general manager of the Boston Electric Light Co., remarked that his company had spent large sums of money in finding out the very best wires and cables to be had, and they had adopted them. As a fact, the system which he represented in Boston was the very best to be found anywhere in the country. The high potential currents they were handling successfully were not so dangerous or so troublesome as was generally imagined. His opinion was that the reason for some of the fatal accidents was organic disease from which the victims were suffering at the time the accident occurred. The new construction that was being done by his company at the present time was of the very best kind possible.

In reply to Mr. Farnham who asked if alternating circuits were being run underground, he stated that about one-third of their underground circuits were used for the transmission of alternating current. Of course an alternating current cannot be run through a wire that had an iron sheathing.

Mr. S. Hosmer said the objection to overhead wires could be largely removed by a proper system of examination and testing. There was greater possibility of a circuit being utterly destroyed underground than overhead, for the reason that they were not so thoroughly tested. They had various instruments for testing, which were used every morning, thus securing immunity from danger or trouble.

Mr. Bennett, of the Cambridge Electric Light Co., said that as representing those who had money invested in the electric business, he was satisfied to know that ere long the city from which he came was going to assume the responsibility of paying its own lighting bills. Their legislators and others had done much in the past to depreciate the value of the property of private investors. It remains to be seen how successful the change would be.

Mr. F. E. Barker, State Electric and Gas Commissioner, could understand why some men engaged in the electric business had tried to get even with himself as a commissioner. The great benefit of such a gathering was that it afforded opportunities for mutual exchange of opinions between men who are engaged in the gas and electric businesses. The placing of wires underground was proving satisfactory and dangers were being obviated by the changes effected. There were problems now and again presenting themselves for solution, and when some of the troublesome points came to be dealt with by the State Commissioners it would be found that their interests were largely identical.

Mr. G. W. Blodgett called attention to the fact that there was a possibility of their organization being allowed to use a room in the Institute of Technology when a paper was to be read and electrical instruments were required. Under such an arrangement a very slight expense would be incurred while great advantages may be derived.

To act upon such a suggestion a committee was appointed to ascertain what was the feeling of those present in regard to effecting a change as indicated.

Captain Brophy acknowledged that a few years ago he was opposed to placing wires underground. His opposition at that time was owing to the fact that there was no insulation fit for being placed underground. Things were different now and today he favored the placing of wires underground. His objection to the poles on which current was carried applied only to high potential currents. There was little or no danger in the 500 volt current used by the railway trolley system. A hearty vote of thanks was passed to the essayist of the evening, after which the meeting closed.

NATIONAL BROTHERHOOD OF ELECTRICAL WORKERS.

The fourth biennial session of the above organization was held at Washington, D. C., last week, when H. W. Sherman, of Rochester, N. Y., was re-elected as president; F. J. Roth, J. H. Maloney, P. H. Wissinger, E. Colvin and A. F. Snyder were elected vice-presidents; J. T. Kelly, of St. Louis, grand secretary, and John Hisserich, of St. Louis, grand treasurer.

WESTERN SOCIETY OF ENGINEERS.

Mr. George P. Nicholls read a paper before the Western Society of Engineers at the Armour Institute, Chicago, on November 21st, on the subject of the "Application of Electricity to Industrial Purposes." The matter gone into included central station, long-distance distribution and transmission, mill, mining, and drawbridge work. It was illustrated by about thirty lantern views of subjects covering this field. A very interesting discussion followed, which was participated in by several of those who were present. Mr. B. J. Arnold also gave some very interesting figures from tests which he made on electric elevators. Notwithstanding the unfavorable state of the weather, the meeting was very well attended.

Legal Notes.

THE DETROIT CITIZENS STREET R. R. PROTECTED BY THE U. S. SUPREME COURT.

The controversy between the City of Detroit and the Citizens' Street Railroad Company of that city was settled in the Supreme Court of the United States on Nov. 11 in favor of the company. The officials of the city sought to forfeit the company's charter, and the Court of Appeals for the Fifth Circuit decided against them. An application was made to the Supreme Court of the United States three weeks ago for a writ of certiorari, to bring the case up for review, which the Chief Justice announced on Nov. 11 had been denied. This determines the case in accordance with the judgment of the Circuit Court of Appeals.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED NOV. 26, 1895.

Accumulators:—

Plate for Secondary Voltaic Batteries, W. A. B. Buckland, London, Eng., 550,480. Filed July 15, 1895.
The plate consists of parallel bars to which the active material is held by flattened strips of celluloid.

Alarms and Signals:—

Register for Fire Alarm Systems, N. H. Suren, New York, 550,463 Filed Jan 29, 1895.
Railway Signal, J. G. Schreuder, Edgewood, Pa., 550,535. Filed Apl. 20, 1895.
A construction whereby the signals will be more distinctly visible at all times and the signaling discs more easily shifted.
Track Instrument for Electrically Controlled Railroad Signals, C. H. Sherwood, Utica, N. Y., 550,566. Filed Dec. 10, 1894.
An improved construction of the track instrument and means for transmitting motion therefrom to the circuit controller.

Distribution:—

System of Electrical Distribution, O. B. Shallenberger, Rochester, N. Y., 550,355. Filed Oct. 12, 1886.
A three-wire alternating system, the converters having their secondary coils connected in series with each other, their free terminals being respectively connected with the positive and negative wires of the system and their remaining terminals with the neutral wire, and a source of alternating or intermittent currents of electricity with which the primary coils are connected in multiple arc.

Dynamos and Motors:—

Commutator Brush, N. M. Cross, North East, Pa., 550,252 Filed Oct 29, 1894.
Composed of a central core of sheet metal, having stiffness and resiliency, and an outer coating or mass formed by winding metallic gauze thereon.
Self Exciting Constant Current Alternator, A. Schm'd, Allegheny, and B. G. Lamme, Pittsburg, Pa., 550,354. Filed Aug. 21, 1891.
The combination with the field exciting coils of an electric generator, of compensating or opposing coils on the armature connected in series therewith and developing a counter potential.
Commutator, J. Dice, Wilkinsburg, Pa., 550,407. Filed Aug. 21, 1895.
A commutator having outwardly projecting flanges and grooves formed in its periphery, and a band encircling said commutator between said flanges.
Dynamo-Electric Machine, E Thomson and M. J. Wightman, Lynn, Mass., 550,464. Filed Dec. 2, 1889.
Relates to winding of armatures of unipolar machines.
Electric and Fluid Locomotor, G. Westinghouse, Jr., Pittsburgh, Pa., 550,-467. Filed Feb. 5, 1892.
The combination with an electric motor, of a rotary eccentric piston pump, composed of two sections, one adjustable as to its eccentricity, and a rotary eccentric piston engine receiving fluid under pressure from said pump.
Ventilating Means for Electrical Apparatus, G. Westinghouse, Jr., Pittsburg, Pa., 550,468. Filed May 2, 1895.
For description see page 543, this issue.

Electrometallurgy:—

Electrodepositing Apparatus, H. L. Bridgman, Blue Island, Ill., 550,403. Filed Dec. 22, 1894.
The cathodes are rotated and brushed.

Galvanic Batteries:—

Well for Batteries, J. G. Schreuder, Edgewood, Pa., 550,533. Filed Dec. 2, 1893.
Provides a battery-well which will not be affected by moisture and will not be displaced by movements of surrounding earth.
Battery Well, J. G. Schreuder, Edgewood, and S. H. Stupakoff, Pittsburgh, Pa., 550,534. Filed Oct. 25, 1894.
Provides a reservoir or chamber for the collection of water and for the drainage of the battery-well. Intended for railway signals.

Lamps and Appurtenances:—

Electric Arc Lamp, F. Emery, New York, 550,365. Filed Apl. 22, 1895.
Improvement on lamp patented by E. J. Murphy, 531,412.

Lighting:—

Electric Car Lighting Apparatus, W. Biddle, Brooklyn, N. Y., 550,242. Filed Mch. 7, 1895.
Details of generator, etc., for lighting from power derived from the car axle, in combination with a storage battery.

Miscellaneous:—

Electric Mining Machine, E. C. Morgan, Chicago, Ill., 550,283. Filed Dec. 12, 1894.
Details relating to a chain cutting machine.
Electrically-Controlled Clutch Mechanism, J. E. Stannard, Springfield, Mass., 550,396. Filed April 5, 1895.
Electrical Pumping Apparatus, G. Rennerfelt, Arvika, Sweden, 550,389. Filed July 16, 1894.
The combination of suitable pumping mechanism with an electric motor in a self contained apparatus in which the pumping cylinder and magnet core are united in a single mechanical element.
Electric Pumping Apparatus, T. G. Rennerfelt, New York, 550,330. Filed July 3, 1895.
The combination with an electric motor, of a series of pumping cylinders placed in and forming a part of the magnetic field of the motor.
Electric Lighting Gas-burner, J. M. Auck, Philadelphia, Pa, 550,432. Filed Mch. 29, 1895.
Consists of the novel construction and application of a spring to the cock which regulates the supply of gas, whereby the movable electrode can be temporarily held in any desired position.
Apparatus for Lighting Miners' Safety Lamps, W. Ackroyd, Birkenshaw, & W. Best, Morley, Eng., 550,459. Filed Jan. 11, 1895.
Apparatus for lighting miners' safety lamps through the medium of a spark caused by the broken contact of two electrical conductors.

Railways and Appliances:—

Electric Tramway with Underground Distribution of Current, A. Diatto, Turin, Italy, 550,319. Filed Sept. 18, 1894.
Carriage is equipped with means for receiving the electric current through magnetic induction from a source of underground distribution by sliding over contact-pieces.
Electrolocomotive, J. J. Heilmann, Paris, France, 550,344. Filed Feb. 18, 1895.
The armature is mounted centrally upon the axle and flexibly connected to the driving wheels.
Electric Car Truck, L. J. Hirt, Somerville, Mass., 550,398. Filed March 5, 1894.
A truck frame comprising straight side bars extended beyond the car axles of the truck, and independent pocketed spring supports extended in line with and beyond the ends of the said side bars and detachably secured thereto.
Electric Railway, D. Brooks, Jr., Philadelphia, Pa, 550,437. Filed Feb. 28, 1894.
In an electric railway, a rail formed of a strip, and a trough thereon, an electric conductor in contact with said strip, and supporting insulators, said rail and conductor being supported by said insulators.
Trolley, E. L. Richter, Philadelphia, Pa., 550,458. Filed March 27, 1895.
An auxiliary trolley is attached to the trolley pole to avoid breaks.
Electric Railway, G. Westinghouse, Jr., Pittsburg, Pa, 550,465. Filed June 13, 1890.
For description see page 549, this issue.

Regulation:—

Controlling Apparatus for Electromotors, J. B. G. A. Canet and A. Hillairet, Paris, France, 550,481. Filed Aug. 28, 1894.
Relates to switches, clutch, motor, etc., for elevator work.
Electric Regulator, G. W. Colles, Jr., Hoboken, N. J., 550,484. Filed Feb. 4, 1895.
Electro-mechanical organizations for governing a steam-engine driving an electric generator.

Switches, Cut-Outs, etc.:—

Electric Switch, T. Harper, New Brunswick, N. J., 550,411. Filed Aug. 29, 1894.
Details of construction.

Telegraphs:—

Apparatus for Hanging and Cleaning Telegraph or Telephone Wires, A. Custodis, Dusseldorf, Germany, 550,255. Filed May 15, 1895.
A combination of pulleys and scrapers.
Non-Welding Contact, A. J. Wurts, Pittsburg, Pa, 550,360. Filed Apl. 11, 1895.
For description see page 548 this issue.
Telegraphy, I. Kitsée, Philadelphia, Pa., 550,510. Filed May 25, 1895.
A system of telegraphy without wires. Throws high potential alternating impulses on the lines which are received by a vacuum glow lamp.
Telegraphy, I. Kitsée, Philadelphia, Pa., 550,511. Filed Sept. 7, 1895.
Sends alternating impulses over the line which are received by a vacuum glow lamp.

Telephones:—

Telephone-Circuit Signal, M. A. Edison, Chicago, Ill., 550,260. Filed May 29, 1895.
Improvements on the type in which an incandescent lamp is the signaling means, instead of a drop.

NEWS AND NOTES.

ELECTRICITY IN THE ARGENTINE REPUBLIC.

THOMAS A. EDDY, of Flint, Eddy & Co., of New York, who went recently to Buenos Ayres to establish a branch office for his firm, has made a careful study of the trade and agriculture of Argentina and Uruguay. Mr. Eddy says that, to him, the most striking fact is the enormous agricultural development of those countries. There is no doubt that they will in the near future become the granary of the world, as well as supply great quantities of beef and mutton to Europe. The conditions of life in Argentina and Uruguay are so similar to those of the United States that the wants of the population are alike, and afford to the American manufacturer the greatest opportunity for the introduction of American goods. The trade in agricultural implements from the United States, already great, is susceptible of greater expansion. The large cities of the two republics are for purposes of public and private illumination rapidly changing from gas to electricity, and large orders are being placed with the electrical companies of the United States. The opportunity for the extension of business in electrical supplies is almost unlimited. Every street in Buenos Ayres, Montevideo, and Rosario is traversed by street cars, and the facilities for transportation of passengers are probably greater in proportion to population than they are elsewhere.

It has been said that the low price of horseflesh in the two republics would preclude the possibility of the introduction of electric traction; but when it is considered that steam coal may be laid down in Buenos Ayres from England and the United States at from $5 to $5.25 per ton, it does not require great arithmetical ability to demonstrate that electricity can be properly substituted for horses.

POLITICIANS AS ELECTRICAL ENGINEERS.

There is no doubt but that a well-managed private plant will furnish better and cheaper light than a municipal station operated by politicians, and in most cases when the service is inferior it will be found that the blame should be divided between the corporation and the city government. The best plan for securing well-lighted streets is to elect councilmen who will insist on having the best in the market and are willing to pay a fair price for it.—*Providence Journal.*

TACOMA CITIZENS MAKE GOOD A DEFICIT.

Fifty-two thousand dollars were deposited by the City of Tacoma with Blair & Co., of New York, on Nov. 30 to pay the interest maturing Dec. 1 on its water and light bonds. Owing to the failure Oct. 24 of the bank in which the city interest fund was deposited, the city was without money to pay these coupons when due, and, as the Council could not legally transfer from other funds for this purpose, and to avoid default and maintain the city's credit, 150 citizens subscribed and paid the money necessary to cover the deficit.

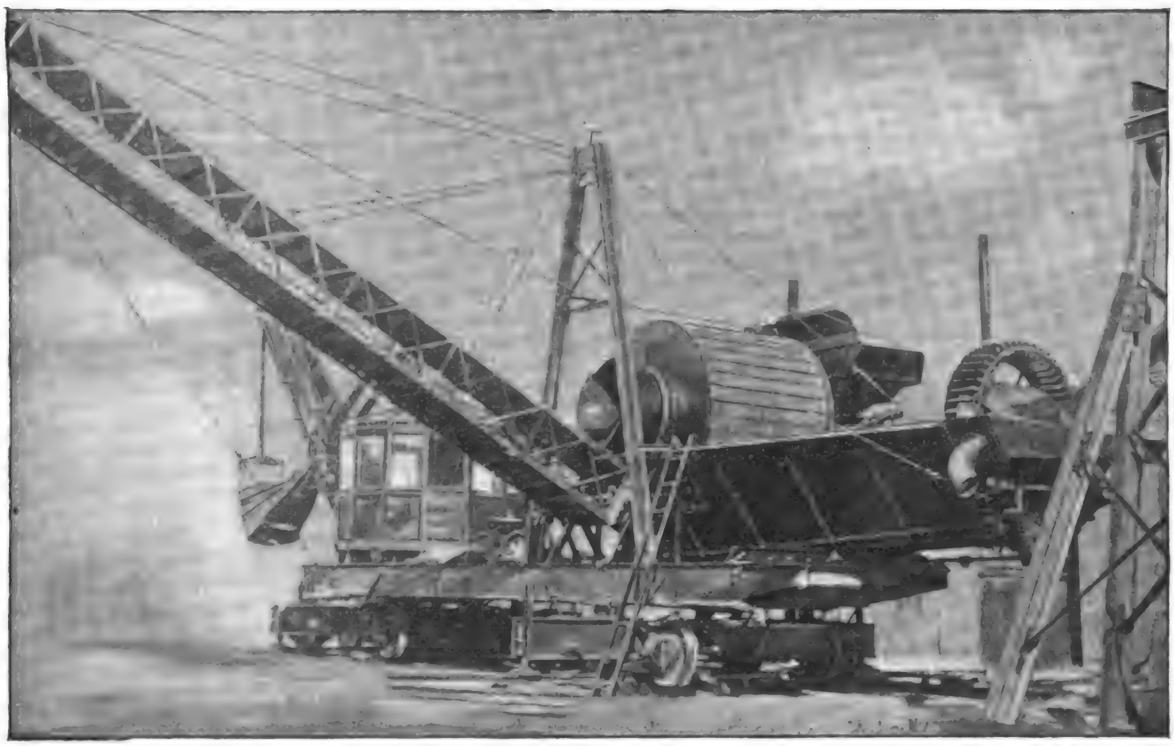
Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

BENNETT AMALGAMATOR OPERATED BY G. E. MOTORS.

A SOMEWHAT unique application of electricity and one of interest to the mining industry has recently been made in the adaptation of electric motors to the operation of a Bennett amalgamator. The amalgamator consists essentially of the following parts: A truck and frame for supporting the larger part of the machine, arranged to be run forward on a track as the work progresses; a turn table supporting a boom and dipper; the boom and dipper for excavating the dirt and a revolving cylinder or screen with a hopper. Into this the earth is thrown from the revolving screen, the finer material passing through into the amalgamator, the coarse material being discharged at the end of the drum into the tailings carrier.

The amalgamator is a large trough, in which the fine material after passing through the screen is amalgamated. In the bottom of the amalgamator is an agitator, moving backwards and forwards to keep the material well stirred up, and a wheel for raising and discharging the fine tailings after the removal of the gold.



BENNETT AMALGAMATOR OPERATED BY G. E. MOTORS.

The four motors used in operating this machine have been supplied by the General Electric Company, and are constructed so as to be thoroughly protected from water or dust. One of these motors is mounted on the frame of the machine between the turn table carrying the cab and the revolving screen. It is geared to a shaft connected by a sprocket chain to the revolving cylinder, the tailings carrier, the agitator in the amalgamator and the wheel for discharging the tailings at the outer end of the amalgamator. A clutch is provided to throw it into gear with the trucks for moving the entire machine backwards and forwards.

The second motor is placed in the cab and operates the dipper by means of a fine wire rope, passing around the drum to which the motor is geared. The third motor is mounted on the dipper boom and is geared to a drum placed just above it. Fine wire ropes pass around this drum and are attached to both ends of the dipper handle. The dipper may thus be thrust out or in, according to the requirements of the work.

The fourth motor occupies a place in the cab and drives the turn table by means of a beveled gear and large sprocket chain. This motor is also used to swing the dipper boom around from the front of the amalgamator to a position which allows of the dirt being thrown into the hopper of the revolving screen. The motor operating the cylinder, the tailings carrier and the agitator in the amalgamator runs continuously when the machine is in operation and is provided with a simple starting rheostat only. The other three motors are controlled by reverse rheostats in the cab and are handled by one man.

BRISTOL'S RECORDING INSTRUMENTS.

THE new descriptive price current of the Bristol Company, Waterbury, Conn., who have a New York branch at 121 Liberty St., includes details of the numerous recording instruments for pressure, temperature, and electricity, manufactured by the company. The company have had much success with their recording vacuum gauges, pressure gauges, thermometers for ovens and closed spaces, volt meters for direct and for alternating current, ampere meters for direct and for alternating current, watt meters for direct current, and a large variety of other portable and stationary recording instruments.

ROLL DROP COMMUTATOR BARS.

The Forest City Electric Company have issued a complete illustrated catalogue of their roll drop commutator bars. The bars are cast from pure lake copper, and rolled or drop forged to size by special machinery. They are toughened by a mechanical process, which produces a quality that allows of the commutator glazing over, reducing the mechanical friction of the brush, and adding greatly to the life of the commutator. The result is a dense accurate bar, possessing superior durability. Any given size can be supplied at short notice. The Forest City Electric Company have their factory at Cleveland, O., with offices at 126 Liberty St., New York, and 1439 Monadnock Building, Chicago.

CATALOGUE OF THE BALL ENGINE COMPANY AUTOMATIC CUT-OFF ENGINES.

WE have received the new, elaborate and handsomely illustrated catalogue of the automatic cut-off engines of the Ball Engine Company, of Erie, Penn., in which the various forms of these well-known machines, horizontal and vertical, belted and direct connected, simple, tandem-compound, and cross-compound are described and shown. The high repute of these engines has been secured and maintained by the use of every modern resource for the attainment of simplicity, compactness and solidity. Excellence of material and fitting is secured by most careful attention and a rigid system of inspection. The company claim that their machines give long and profitable service, at the minimum cost for attendance and repairs, which constitutes the truest economy. They also guarantee a given amount of horse power, for a term of years, at a less cost than can be realized from any type of long stroke, slow-speed engines, each engine to work under like conditions.

A FIFTY LIGHT ARC PLANT WANTED AT LAKE CITY, FLA.

The Lake City Water & Light Co. write us that they want the best quotations from manufacturers and contractors on a 50-light arc dynamo, lamps, wire, cross arms, &c. Bids should be sent in at once, as the company has a contract to fill for lighting the streets of the city for ten years, and must begin operations.

PRIZES AT THE BOSTON MECHANICS FAIR.

The judges have recommended that silver medals be awarded to the following exhibitors: O. C. White & Co., incandescent lampholders; Whittier Machine Company, improved electric elevator; Holtzer-Cabot Company, motors, dynamos, etc; Williams & Couch, electric telephones; New England Telephone & Telegraph Company, telephone in operation; Charles A. Beal, incandescent lamp.

STANDARD ELECTRIC CO.

The *Columbus, O., Lantern* of November 6, says: "The disposition of manufacturers of electrical apparatus to be well represented at the Ohio State University is typified in the recent action of the Standard Electric Company of Chicago. A year ago last May a 20-light arc dynamo was made especially for us from the latest designs. Since that time the company has improved the regulating apparatus used on the machine and has sent without expense to us, the entire set of new parts necessary to adapt this new method of regulating to the old machine."

THE IDEAL HIGH ART ENGINE.

WE have received an embossed cut in colors of the Ideal High Art Engine, manufactured by A. L. Ide & Son, Springfield, Illinois. The specialty of this engine is smooth and noiseless running—its bearing being cushioned on a film of clear oil—and long life to the wearing parts. A. L. Ide & Son offer, upon receipt of 10 cents, in postage stamps, to send any applicant a pack of playing cards that retail for 35 cents in any store.

THE PORTLAND, ORE., TRANSMISSION PLANT.

In our description of this plant, appearing in the issue of Oct. 9, it was inadvertently stated that the 4-wire system is worked at 1000 volts between wires and by means of feeder regulators a variation of 4 per cent. in either direction is covered. This should read: The 4-wire system is worked at 133 volts between any two wires and by means of feeder regulators a variation of 7½ per cent. in either direction is covered.

ADVERTISERS' HINTS.

THE BRYANT ELECTRIC CO. continue to manufacture the "K. W." rosettes and receptacles. Their catalogue may be had on application.

AN EXCELLENT TESTIMONIAL appears in the "ad." of Mr. F. M. Locke regarding his steel insulator pins. There are others to follow.

THE CENTRAL ELECTRIC CO. invite all to "come into the fold" and select their house goods from the largest stock in the U. S.; annunciators, bells, batteries, wire—everything.

THE ELECTRIC APPLIANCE CO. draws attention to the difference between poorly insulated wires and Paranite, and proves the wisdom of using a high grade covering.

RHEOSTATS for generators and motors are carried in stock by the Carpenter Enamel Rheostat Co. This includes all manufactures and all sizes ordinarily used. They also make electric soldering irons, curling irons and heaters.

A JUTE AND HEMP COVERED CABLE that is well preserved after six years of service in the bottom of a river is a good thing. The India Rubber and Gutta Percha Insulating Co. can tell you all about such cables because they make them.

THE SOUTHWARK FOUNDRY AND MACHINE CO. build the Porter-Allen automatic engine and claim that it possesses advantages that make it the most desirable where high economy and close regulation are essential.

THE WESTINGHOUSE ELECTRIC AND MFG. CO. are advertising the merits of the Tesla polyphase system. Their sales of polyphase alternating current generators aggregate 3,000 H. P. to 1,000 H. P. of single-phase alternators.

THE CALCULAGRAPH is the latest means of keeping tab. It calculates the value of elapsed time and prints the result in dollars and cents. Telephone companies will find it a material aid in exchanges and pay stations.

ENGLISH CAPITAL FOR VANCOUVER LIGHTS AND TROLLEYS.

A Vancouver, B. C., despatch tells of the purchase through London bankers by an English syndicate of the Vancouver Electric Tram Company, Vancouver Electric Light Company, the New Westminster and Vancouver Inter-Urban Electric Tram and Electric Light Company, running a distance of twelve miles, and the New Westminster City Electric Tram Company. Half a million dollars will be spent in utilizing the water power of the Seymour River to run the entire system. An English syndicate has also bought the Victoria Tramway.

A WESTERN ELECTRIC PLANT FOR VANCOUVER.

C. D. Crandall, president, and T. H. Cowan, secretary of the newly incorporated Western Electric Lighting, Heat and Power Company, have duly accepted the offer of Vancouver made to their representative, subject to certain provisions, to light the city with electricity, 2,000 candle power, for 27½ cents per light up to 200 lights; over 200 to 250, 27 cents, and above that, 26 cents per night for 310 nights.

WESTERN NOTES.

THE "SILVER CITY" TELEPHONE COMPANY, of Argentine, Kan., have adopted the "Standard" telephones and the Grand Avenue Electrical Works of Kansas City, Mo., are placing them as rapidly as wires are built. This exchange is under the management of Mr. Geo. W. Simmonds as Supt. and Miss Lizzie Simmonds, manager.

ELECTRIC APPLIANCE CO.—With their greatly increased warehouse and shipping facilities, the Electric Appliance Company are able to carry an increased stock of "O. K." and Paranite wires and line material. It is their purpose to ship all orders for these goods from Chicago stock immediately on receipt of orders and their present facilities enable them to do so without difficulty. They claim that their line of everything that properly comes under the head of electrical supplies is not excelled by any supply house in the country, either in the merit of the goods or in the amount of stock carried.

THE GRAND AVENUE ELECTRICAL WORKS of Kansas City, Mo, have placed six "Standard" telephones in as many stations with the Metropolitan Railway Company upon their electric line between Kansas City and Independence, a distance of ten miles. The telephone wires form a metallic circuit around the feed wire carrying a 500 volt circuit and only distant from this feed wire about twelve inches. The induction from this high pressure current does not affect the telephones in the least. The railway company operate this line entirely by telephone having a very heavy park travel both winter and summer.

THE GATES ELECTRIC MANFG. CO. have received propositions from the cities of Elkhart, Ind., and Goshen, Ind., to build a brick factory, two stories high, 75 x 200 ft. with out-buildings, giving them ground 150 x 300 ft., and also to put in side tracks, provided they will move their plant to either of these towns. Their business has expanded greatly and other propositions looking to the securing of better shipping facilities, are under consideration. The Gates Co. report the sale of a complete electric-light plant for the United States Insane Asylum, at Phoenix, Ariz. This plant will comprise one 25 kilowatt multipolar generator, with handsome slate switchboard; one Ideal engine, and complete storage battery plant of the Electric Storage Battery Co. type. They have also sold for the United States Prison at Yuma, Ariz., a complete electric-light outfit, practically the same as at Phoenix. They have installed a 75 H. P. multipolar, 250 volt motor, in the works of Fraser & Chalmers, Chicago. They are installing a 60 kilowatt multipolar dynamo in the Stamford Hotel, Chicago; and report under contract, four 100 K. W. railway generators; and one 80 K. W. railway generator. The Gates dynamo is meeting with marked success.

NEW YORK NOTES.

MR. J. H. RHOTEHAMEL, president of the Columbia Incandescent Lamp Co. has been visiting New York again. He is greatly pleased with the beautiful effect of his decorative lamps in the new restaurant of the Imperial Hotel.

THE SOLAR ELECTRIC COMPANY of 65 and 67 Duane street has applied to the Supreme Court for the voluntary dissolution of the company, and Judge Beekman has appointed Senator Jacob Rice, of Kingston, one of the directors, receiver, with a bond of $8,000. The liabilities and assets are small, and there is a suit for $10,000 damages against the company, brought by Thomas Paterson, of Elizabeth, for injuries to his hand. The company was incorporated last July.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

Vol. XX. DECEMBER 11, 1895. No. 397.

POWER TRANSMISSION DEPARTMENT.

EDDY MOTORS IN THE CAMPBELL WALL PAPER FACTORY, NEW YORK CITY.

GRADUALLY but surely the owners of establishments in which power is required are beginning to recognize the serious losses which accompany the methods of power distribution involved in the transmission of belting from engine to the furthest machine to be driven. Tests have shown that even with all machinery in operation in large mills, 25 per cent. more of the power developed by the engine is consumed in friction by the shafting, and this percentage of loss evidently increases in the same ratio as the number of machines in operation decreases. On the other hand, it has been shown that with the machine driven directly by motors or through short lines of a shafting electrically driven, the loss from this source is greatly reduced. Intelligent factory owners are therefore turning to the new method. One of the most recent interesting examples of the substitution of electricity for the counter-shaft is the installation recently completed in the Campbell Wall Paper Factory situated in Twenty-fourth street, near the East River, New York City.

This factory consists of two buildings, the older one being 45x200, and the new building 100x200, both six stories in height. Heretofore power has been transmitted the whole length of the long building, 200 ft., by shafting and transmitted by counter shafts up through the various floors. The consequence was that even when the machinery on only one floor was running, the shafting in the whole building was put in motion. The subdivision of departments and installing of a motor for each division now makes it possible to shut down any department without turning an unnecessary wheel.

The current is generated by two 60 K. W. 220-volt, and one 40 K. W., 110-volt Eddy generators. The former are used for power transmission exclusively, while the latter is used for lighting purposes. These machines are driven by a counter-shaft with clutch coupling for each, machine, so that one or both may be operated as the work demands.

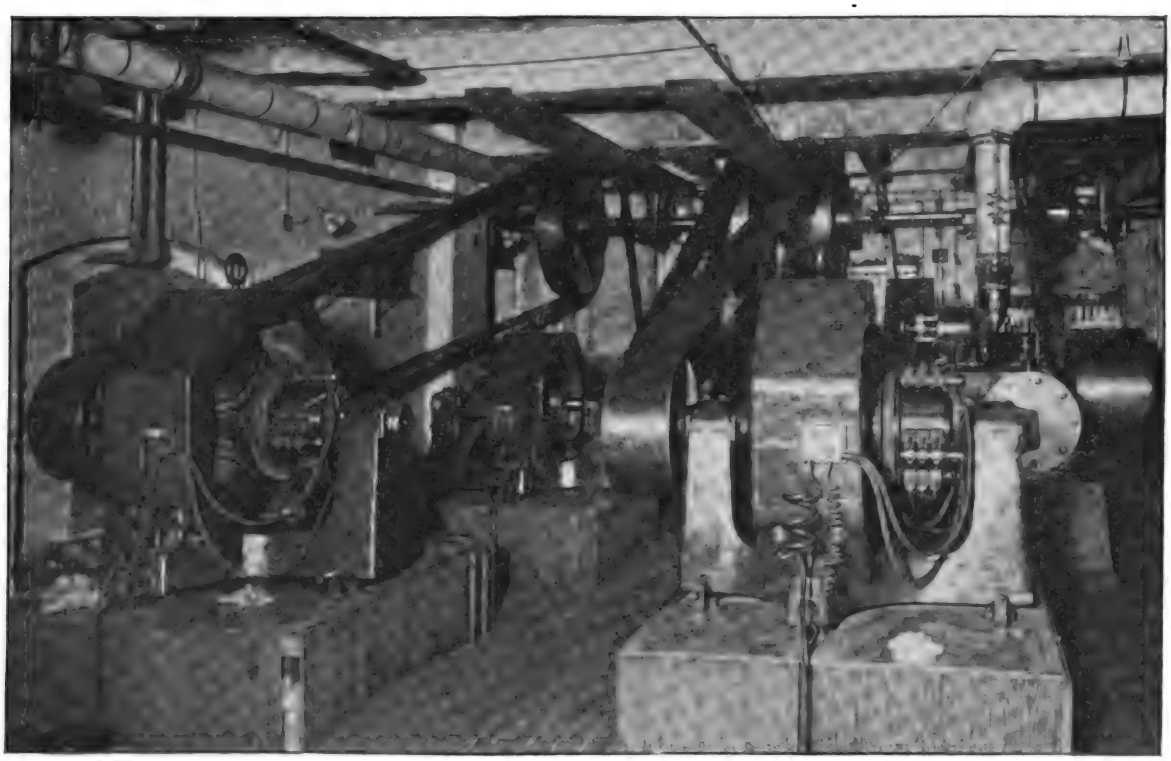


FIG. 1.—EDDY GENERATOR PLANT FOR LIGHTING AND POWER, CAMPBELL WALL PAPER FACTORY, NEW YORK.

This generator plant is shown in the accompanying illustration, Fig. 1. It includes an Armington & Sims 180 H. P. engine. The character of the plant will be appreciated when it is stated that not only is the engine mounted on a heavy brick foundation, but the dynamos also are bolted to heavy brick piers as solid as those of the engine itself. The result is that the plant runs without a particle of tremor or vibration. The switchboard, shown in Fig. 2, contains the necessary switches, voltmeters and ammeters and is specially embellished by a border of wall paper of artistic design, a product of the factory.

Altogether, there are five motors of various sizes in

operation in the building. The second floor on which the embossing and pressing of the wall paper is done, is operated by a 40 H. P. type H, Eddy motor, which also by belting drives corresponding sections of the third, fourth, fifth and sixth floors. On the south side of this same floor a 25 H. P. motor runs the reels on all floors of the old

Fig. 2.—Switchboard, Campbell Wall Paper Factory, New York.

buildings. On the third floor, which constitutes the main reel floor, is situated a 25 H. P. motor, illustrated in Fig. 3, which runs two elevators of two tons capacity, and with

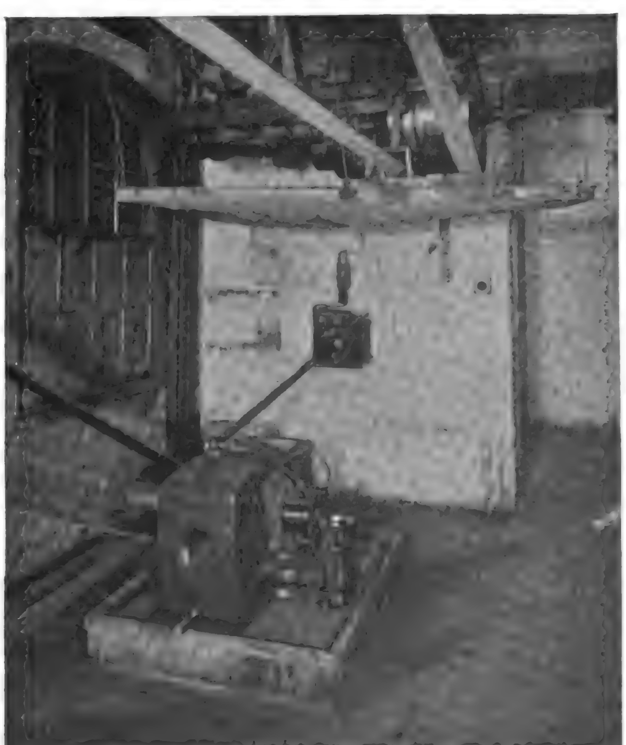


Fig. 3.—Motor Operating Elevators and Reels.

a freedom from sparklessness which is truly phenomenal, considering the great variations in load, to which the motor

Fig. 4.—50 H. P. Motor Driving Printing Rolls.

is subjected. This same motor also drives all the reels in the new building at the south end.

The machinery on the fourth floor is driven by a 50 H. P. motor placed on the floor above. Here there are situated

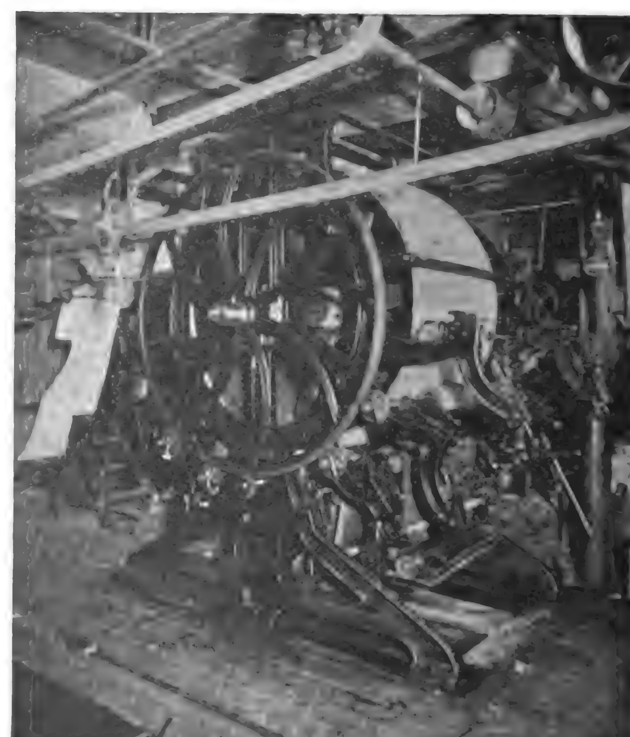


Fig. 5.—Wall Paper Printing Rolls, Driven by Electric Motor.

six 8-color printing machines in the new building, and two 6-color machines in the old building, the latter of which

are run from the 40 H. P. motor on the second floor mentioned above. The 50 H. P. motor placed on the fifth floor and shown in Fig. 4 operates four 6-color and two 4-color machines, placed in the new building, while at the same time it drives all the machinery at the north end of the third, fourth, fifth and sixth floors. On the fifth floor in the old building a 12-color machine and one 8-color machine are also operated from the 40 H. P. motor on the second floor. Finally, a 10 H P. motor, also situated on the fifth floor, drives a short line of shafting to which was belted the tools of the machine shop. The 50 H. P. motor on the fifth floor, also drives eight grounding machines and eight reeling machines on the top, or sixth floor, being connected through to the motor below by a counter-shaft and clutch. The high grade work which is required from the motors in this establishment will be appreciated by a glance at the engraving, Fig. 5, which shows one of the color printing machines, which require very uniform speed. The same is the case in the reeling of the wall paper after it is printed and dried, any abnormal variation in speed causing breakage of paper and irregularity in the printing.

The conductors required for this work consist of two lines of No. 0000 feeders, running up to the third floor, in which the drop does not reach one volt From the third floor branches are taken to the fifth on a No. 0000 wire to the 50 H. P. motor, and one line of No. 0 to the 10 H. P. motor. The wiring work was carried out by Mr. W. J. Parkus, engineer for the Campbell Wall Paper Co., and the installation as a whole, is creditable alike to him and to Messrs. H. B. Coho & Co., agents for the Eddy Electric Mfg. Co., who furnished all the electrical apparatus.

DIRECT VS. ALTERNATING CURRENTS FOR LONG DISTANCE TRANSMISSION.—II.

Wm Baxter Jr

UP to this point the merits of the two systems have been considered wholly upon the question of efficiency of transmission, and without any regard as to practical adaptability. Therefore, if the reasoning is sound, the direct current would be the most desirable even if the alternating system were just as well suited to commercial requirements, which is not the case.

The only extensive application of the alternating current at the present time is for incandescent lighting. A few "arc" lights are also operated by it, but for this purpose it is far inferior to the direct current. Any one desiring to install an arc lighting plant, would not take the alternating system into consideration for a moment. Arc lamps of this type are only used where they are so far apart or so few in number as not to justify the expense of a separate circuit.

For motor services it may be justly said that at the present time the alternating current is of no great practical value.

The multiphase motor, when considered from a purely theoretical standpoint, should be equal in every respect to the shunt wound constant potential motor of the direct current type. It will start under a heavy load, as the rotating field exerts a torque which increases as the velocity of the armature is reduced, and is at its maximum when the armature is at a standstill. The action of these motors, if considered without any reference to external objects, is the same as that of the ordinary direct current machine. In the former, the lines of force, or the magnetic polarity, rotate around the field, and the armature chases around after them until it catches up and then they continue rotating together. In the direct current machine the lines of force remain stationary in the field, and by the action of the commutator they tend to rotate backward in the armature ; thus setting the latter in motion in the forward direction. In both cases these lines of force remain stationary in one part of the machine and rotate through the iron in the other.

Although from a purely theoretical standpoint, there is nothing to prevent the rotary field motor from doing the same kind of work as the shunt wound constant potential motor, the fact that it has not come into use is an indication that there is some practical obstacle in the way. That this obstacle is of no small importance may be assumed from the fact that it is about eight years since the first of these machines was made, and still they are not in use except in a few isolated cases.

In all probability the multiphase motor will come into use to a certain extent for manufacturing purposes or whenever a constant speed is required but until very decided improvements are made it will be entirely excluded from the railway field or for any purpose where a variable speed is necessary.

Summing up the foregoing we see that the alternating current is well adapted to incandescent lighting, can be used for arc lighting in case of necessity, theoretically, can be used to operate constant speed motors, but is not yet in use except in a few isolated cases, and cannot be used for railway motors, or other cases where a variable speed is required.

It is not surprising that European engineers are so much in favor of the alternating system. With them, incandescent lighting is about the only practical application of electricity. It is true that they use a few arc lights and stationary motors, and a sprinkling of electric railways, but the development in these lines dwindles into insignificance when compared to what we are doing on this side of the Atlantic. Very few, even among those engaged in electrical work, are aware of the fact that in New York City alone there are several thousand motors used for manufacturing and for operating elevators, while small fan and sewing machine motors are as numerous as flies around a candy store.

With us, incandescent lighting is but a small portion of the electrical industry. The field which is now of the greatest importance and which bids fair to develop to almost unlimited proportions, is that of electric railways. In this line of work, the plants now in operation have an aggregate capacity of about half a million horse power, and at the rate of present development will soon reach the million mark.

If with us, incandescent lighting were the all important branch of electrical industry, as it is in other parts of the world, it would not be unreasonable to devote a very large portion of our energy to the development of the alternating system, although even under such conditions the direct current should not be cast aside without a fair trial ; but inasmuch as the greatest development at present is along lines in which the alternating current is not adapted, it seems folly to discard the direct current as we have done, without any effort to determine its possibilities, and push forward a system that we know is not suited to our wants, and cannot be utilized at all except with the assistance of the discarded direct current.

We know that one of the principal objections to the alternating current is the increased difficulty of transmission and yet we transmit energy by this system, and at the receiving end convert it into a direct current so that we may be able to make use of it. Would it not be a wiser policy to rectify the current before transmission and thus save, either in cost of construction, wire, or in higher efficiency of transmission ? If it would be wise to go that far, would it not be still wiser to go one step farther and replace the alternator with a direct current generator and thus save the extra loss in transformation as well as in transmission ? Obviously the correct answer to these questions is, that if the direct current can be successfully used at as high an electromotive force as the alternating it would be the one best adapted to our requirements. Before considering this point it will be well to take up the question of cost of installation, as this is a matter of

almost as much importance as the efficiency or adaptability of the system.

So far as all line construction is concerned, it must be conceded that for equal electromotive forces the direct current is the cheaper. There is not only a saving in copper, but also in the cost of insulation.

As to generators, the alternators alone may cost a trifle less than direct current machines, as they do not require commutators. But an alternator by itself is not a complete machine, it must have an exciter, the cost of which would be greater perhaps than that of the commutator of a direct current generator of equal capacity. The alternator can be made self-exciting but it would require a commutator, and its cost then would be about the same as that of a machine with separate exciter.

In the direct current system as suggested above, the current from the generators would pass over the line to the rotary transformers at the receiving end; therefore there would be generators and rotary transformers to offset the cost of alternators, and three sets of transformers required for the alternating system.

As just shown the cost of alternators and continuous current generators is so nearly alike that they may be considered equal in a rough comparison. We then have left for comparison three sets of "static" transformers in the alternating system, against one rotary transformer in the direct system, if the current is to be used for lighting purposes; or two "static" and one rotary in the alternating against one rotary in the direct system if the current is required to operate motors. It is evident that in either case the cost of direct current transformers would be less than that of the alternating. If the current were used for power the difference would be the cost of the two sets of "static" transformers, as the rotary transformer of the alternating system would cost about as much as the rotary of the direct system.

Thus we see that whether the current is used for light or power, the cost of installation of the alternating system will be the greatest. If the step-up transformers are discarded, a considerable reduction can be made in cost of plant, but not enough to enable it to compete with the direct current, certainly not when the installation is intended for power distribution.

It may be considered by many of those who are wedded to the alternating system that the comparison herein made, as to cost of plant, and efficiency of operation are not fair, as they are based upon the supposition that step-up and step-down transformers are required, whereas such a supposition is not necessarily true. It must be remembered, however, that in the foregoing comparison an alternating plant is assumed such as that installed at Niagara.

If step-up and step-down transformers are necessary to make the alternating system practical, then it is quite evident that it is far inferior to the direct current not only in first cost, but in efficiency of operation. It does not follow, however, that because the plants that are now being installed are loaded down with these encumbrances that they are indispensable. It is not at all improbable that future development may show them to be entirely unnecessary, at least if the energy transmitted is used for power purposes. For lighting, step-down transformers would certainly be required so as to avoid running a primary of very high electromotive force into the premises of consumers. But even for lighting, the step-down transformation could be avoided if instead of using a small transformer for each customer larger ones were used in substations. In such an arrangement the primary would go direct to the transformers in the substations, and a secondary of, say, 110 volts could be derived for commercial purposes.

Conceding, therefore, that intermediate transformations are an unnecessary waste and will eventually be discarded, to establish the superiority of the direct current system over the alternating, it must be shown that it is either more efficient or costs less to install when the same number of transformations are made. If we consider a plant used for lighting and operating with but one transformation, it is quite evident that the alternating system would have the advantage, as the "static" transformers would cost less than the rotary transformers required for the direct system, and their efficiency would be higher unless the maximum output were only used for a short portion of the time, in which case the average output might be so low as to make the efficiency of the two systems about the same. If the plant were used for the operation of motors, rotary transformers would be required in both systems, and their cost as well as efficiencies would be about the same. So far, then, as cost and efficiency are concerned there would not be any very great difference between the two systems, when using the same number of transformations, and working at the same electromotive force. The line loss would be less with the direct current, but, as shown above, the efficiency of transformation would be about the same if rotary transformers were used, and would be somewhat higher in the alternating system if the secondary were required for lighting purpose. The difference, however, would not be very great. It might be four or five per cent. higher for the alternating system when used for lighting, but for power purposes the two would be so evenly matched that the difference one way or the other would probably be within two per cent.

If these conclusions are correct, the direct current cannot be superior to the alternating under the condition of equal number of transformations, unless it can be used at a higher electromotive force. I believe it can be demonstrated that it can be used at a considerably higher electromotive force.

THE MEYER THERMOELECTRIC GENERATOR.

A recent issue of the *Electrochemische Zeitschrift* contains a highly interesting account of a new method of operating thermo-generators, which, according to the inventor, Mr. Gustav Meyer, results in greatly increasing the efficiency of this type of apparatus. The essential part of the invention consists in heating and cooling the junction points of the thermo-cell intermittently. This is accomplished by alternately heating one pole of the battery and cooling the other. The following different arrangements may be employed for this purpose. 1. The junction points between the dissimilar metals are revolved in front of a stationary heating and cooling arrangement. 2. The heating and cooling arrangements move in front of the junction points. 3. The heating and cooling arrangements as well as the thermo elements are stationary. The intermittent heating is effected by means of movable screens, placed between the junction points and the heating or cooling arrangements. 4. The heating and cooling arrangements are stationary; the former are controlled by valves, so that the source of heating is temporarily thrown out of action by the cooling arrangements, and vice versa. According to the author, this arrangement permits of the generation of continuous currents, as well as single phase and multiphase alternating currents; all that is necessary being to connect the junctions and sources of heat in the same way as is done in thermo-electric generators. Even with faulty apparatus, the author claims to have obtained an absolute efficiency of 62 per cent., and he asserts that the potential and currents can be regulated to a nicety.

CONDUCTIVITY IN LIQUIDS AND GASES.

Signor Adolfo Bartoli has repeated and confirmed his earlier observations on the electrical conductivity of liquids and gases near the critical temperature, using slightly modified apparatus. Pure benzine has no conductivity either in the liquid or gaseous state—that is, just below and just above the critical temperature. Methylic alcohol and sulphurous anhydride, however, conduct slightly when liquid just below the critical temperature, but lose this feeble conductivity when gaseous just above that temperature.

ELECTRIC LIGHTING.

UNDERWRITERS' RULES.

BY A. E. DOBBS.

THE Underwriters' National Electric Association is now considering needed changes in the rules for the installation of electric light and power and with a view to an exchange of opinions, I would like to suggest some changes which it seems to me could be advantageously brought about.

The first change I would advocate would be that the definitions now placed in the back of the Underwriters' book of rules be incorporated in the body of the book, in different type if necessary, but let us have the rule and its definition all together.

The definitions to Rules 10*a*, 12*a*, 18*a* and 21*b*, require all wires to have a solid covering "at least $\frac{3}{64}$ of an inch in thickness and covered with a substantial braid," etc. It seems to me that this should require two asphaltum soaked braids in addition to to the rubber; or rubber, tape, and braid. Two braids would protect the rubber core from the air and also from mice and insects; while to equalize the cost the thickness of the rubber might be reduced to $\frac{2}{64}$ inch. This would give us a durable wire of high insulation and long life.

Rule 19, dealing with concealed work seems to me unnecessarily restrictive. Sec. *A* requires that all wires must be supported on non-combustible insulators while Rule 18 requires them to be protected by approved insulating bushings in passing through joists and at the same time requires a wire of highest insulation. Now since the insulation of the wire is not to be depended upon, why require a high grade of insulation? When it must be hung on porcelain insulators and be bushed through all joists, why will not a cheaper grade of wire answer? Or if you must have highly insulated wire, why not do away with the porcelain knobs and bushings and require all wires to be run on the loop system so that the wires can be pulled out and changed at any time, and require porcelain tubing where they come through the plaster? It seems to me that triple braid weather-proof wire would be best for this kind of work.

Of course, I favor conduit work, but we often have to deal with the financial aspects of the case just as we have to deal with wooden houses. With proper care on the part of the inspector this kind of wiring would be as safe as any other; besides, it is not so much the methods of running the wire as the outlets that need looking after. Wires run with a joist or studding between them are not going to get crossed or suffer seriously from electrolysis if left to hang free. All wires carrying over 10 amperes should be soldered to copper or brass terminals when brought into the switch or the cut-out screw will work loose.

As to cleats, a rule should be adopted forbidding the use of cleats that break the insulation of the wire. Some cleats now on the market nearly destroy the covering with their saw teeth or sharp edges.

I cannot see the force of the objection to strings being placed in conduits as they are put up. If the inspector has reason to believe that the conduit is not continuous he could easily test the matter by blowing into one end of it. As it is, the wires are now pulled in as the conduit is put up and are twisted and knocked round by the plasterers till the insulation, at the very weakest spot, is considerably damaged. Rule 10, requiring outside overhead conductors to be 12 inches apart, is all right for most cases, but with the extension of alternating systems for power work this might get to be quite an important question. Provided the work is well done it might become desirable to put them much closer than 12 inches; this should at least be considered by the board.

Rule 23*d* requires all cut-outs to be covered. In my opinion the cover should not be on the cut-out itself and should be at least two inches away from the terminals for the reason that when the fuse blows, the arc is a great deal worse in a covered fuse block than in an open one. A fuse block of the old Sawyer-Man pattern, for example, will blow without melting much lead or creating a great deal of heat; this is also true of tablet boards which are not covered as this rule directs; while on the other hand every one has seen the explosive effect of the Edison plugs, and that fuse blocks entirely covered have been almost entirely destroyed by the blowing of a five ampere fuse. It seems that when an arc forms in a covered fuse, the air is driven out, leaving a partial vacuum which maintains the arc for a longer period of time, while in the open fuses the rush of air blows out the arc.

I also hope that the Edison socket with the tongue contact at the base of the lamp will be condemned. Also the Edison 10 ampere snap switches that the General Electric Co. has been putting out lately. They are an all-round nuisance and thoroughly unreliable. There may be others on the market just as bad but these are more generally used. All the rest of the General Electric material is good.

Why do the New York inspectors require asbestos back of switches and cut-outs? I never heard of a cut-out arcing at the back, and asbestos does not improve the insulation.

It is to be hoped that the Committee will provide some method of securing a uniform interpretation of the rules. At present the New York inspectors rule one way, Syracuse another and Boston still another. It is also to be hoped that the rules will be written in plain English, and that the inspectors will be restricted to just what the rules say, instead of each one being a law unto himself, as it is now.

ILLUMINATION vs. GLARE.

BY

Albert Scheible

ONE of the most notable events of the past year was the advent of a practical illuminometer. It was noteworthy not so much because it is more needed to-day than a photometer, but more particularly because it emphasizes illumination as the one thing to be attained by electric lighting. We have learnt to produce light at any desired spot and in any desired unit and we can now do this at a very low cost considering the methods used. Hence it is high time that we should turn our efforts towards using this light to produce the desired effect. In doing so we must remember that it is not the lamps themselves which we want to show; they are merely accessories—necessary evils, perhaps—and as such we gladly tolerate them as means towards our end. That end is illumination. It may be the illumination of a show window, a store, a parlor, a workshop or a street. In each case there is something other than the lamps which we want to exhibit; the lamps themselves can be quite inconspicuous while still supplying the light for the store display, the reception room or the avenue. I say they can be inconspicuous, though as yet we rarely find them to be so.

Not many years ago when electric lighting first came into use the public clamored for it as something new, something that should not only be used but readily seen as well. It was not enough then for the townspeople to know that so intense a light could be produced in so small a space; they wanted to have this intensity kept prominent—wanted to be dazzled by the penetrating rays even if they were thereby kept from seeing what was supposed to be lit up by the lamps. But that era has now gone by. We need no exhibit of arc or incandescent lights in our stores or streets; what we do need is the light itself. To use this in the most effective manner we need to get rid of that exhibition glare which custom has handed down to us as a dazzler and incidentally as an illuminant. Are we doing so to-day? Just look at a few pert examples.

1. *The Show Window.*—Everybody knows that this is the one place above all others where the dealer wants the public to see his wares. Time and expense are seldom spared in causing these windows to serve their proper object. Models are devised to show the proper use of the goods, and artists are set to work arranging them so that the eye will long to rest upon them; the result is a feast for the passer-by. At least it is so in the day time, but rarely so at night, and why? Is it for lack of light?

Certainly not, for hundreds of candlepower are cast on the window in excess of what it received at noonday. Perhaps there is an arc lamp right in front of the window, or there may be a border of incandescents around the edge. In either case it is the lamps and not the goods that catch and hold your eye. You stop and say to yourself: "Oh! How pretty those lights are!" And you go on, forgetting that there were goods in those show windows and that the real purpose of the lights lay not in their being pretty themselves, but in showing up a pretty something else. The true beauty of the light—that of its meek utility—had been entirely missed.

Yet things can be otherwise. There are some stores already where the light in or near the windows is concentrated on the goods and shielded from the observer's eye, where the electric light readily produces the desired illumination without reducing the effectiveness of it by the offensive glare. Perhaps we are too strongly prejudiced in favor of the electric lights; then let us look at gas jets or Welsbach burners in similar locations and with all charity for the latter ask ourselves if even the right light in the wrong place (the glaring, self-conspicuous place) is what we want.

2. *In the Home.*—When we place lights of any kind in the rooms of our house we generally look upon them as mere substitutes for the daylight during the hours when this is not available, and we are justified in calling that method of lighting the best which most nearly approaches the diffused daylight in its effect. We need not pretend to imitate the dazzling sunlight, for we carefully exclude its glare by shutters or moderate it by tinted shades. Thanks to these shutters and shades we get a mellow and diffused light, inoffensive to the eyes but ample for giving thorough illumination to the room. When evening comes it would be only natural for us to reproduce this illumination as best we can, and surely the incandescent lamp is the best medium yet devised for producing a close approach to the daylight effect. But where is the residence which can boast of this mellow lighting by night as well as by day? Surely the grouping of a few incandescent lamps where they can glare right into one's eyes cannot give the desired effect any more than we would get it during the day by admitting the bright sunlight through three or four peep-holes. Custom told us to place our incandescents just where we were used to seeing our oil or gas lamps. But these had to be within easy reach as they needed frequent adjustment, and they also had to be kept at a respectful distance from the wall or ceiling to avoid fires. Fortunately the incandescent lamp is not subject to these same ailments, and as the most modern of the lot it surely should not be handicapped by the faults of its predecessors. If we must have the lamp right before our eyes we can frost its bulb and perhaps enclose it in a much larger opalescent globe, so that we will see not a dazzling white horseshoe-shaped filament but a dimly glowing ball of light. I for one like to see the light dimmed and diffused in this way, and I prefer even then to place the lamps close to the ceiling where they will be least noticed by sensitive eyes. If you can have a number of such glowing globes scattered along the ceiling, each with a lamp of rather low candle power, the result will be so much the better since it more nearly reproduces the diffused daylight effect.

Perhaps you will ask as to the economy of such a plan: "Will it pay to cut off a third of the light by the tinted globe?" I think it will, for it is not so much the candle-power output of our lights that counts, but rather the illuminating effect produced by them. When we put a 16 C. P. incandescent in place of a 10 candle power double gas burner or 8 C. P. of oil lamps, we spend more candle-power of light on the room but do we necessarily get a more effective illumination? Is it not a fact that we strive during the day to keep down the candle-power of light which comes into our rooms, in order that we may have just the amount needed for a proper illumination? Any light in excess of this is injurious to our eyes and detracts from the effect of all the objects when we look at them for any length of time.

If we want to exhibit the lamps themselves we can find many ways of doing this by using the miniature forms now on the market. But for effective and artistic lighting I trust that the time will come when the incandescent lamp will be merely the power behind the globe, from whence it can shed a truly diffused light on our room without being seen of itself.

3. *Street Lighting.*—When we come to the lighting of streets and alleys the question of candle-power is apt to be misleading unless it is kept subsidiary. The fact that lighting contracts when not made on a midnight or an all-night basis are usually taken on a moonlight schedule, shows that the illumination due to the moon in its second or half-moon phase is considered ample for lighting the streets at night. Many small towns have tried to reproduce the moonlight effect by using tower lights, but the shadows from two or three-story houses or from trees of almost any size have spoilt the result in most cases. The more common method of using arc lights at every street crossing is certainly far from giving a moonlight effect. It invariably gives an intense illumination to a spot fifty or a hundred feet in diameter, but when you go beyond this area the intense shadows and the dazzling rays detract from the effectiveness of the illumination, thus leaving the street rather poorly lighted for either riding, driving or walking. It is not a lack of light in this case, but a lack of its proper distribution. In the case of incandescent street lighting there are usually three or four lamps to a block, and while the absolute candlepower per block is much lower, the illumination produced may still be much more satisfactory. The light is more evenly distributed in this case, the lamps are near enough to avoid any deep shadows and the glare of the lights themselves is almost insignificant as compared with that of the arc lamps. This point is noted alike by pedestrians, teamsters, horseback riders or cyclists—in fact by everybody for whose benefit the street is illuminated. The more uniform distribution of the light, together with the absence of the glare and of the intense shadows, all help to bring the incandescent "many-lamps-to-a-block" method much nearer to producing a moonlight or diffused daylight illumination than the usual plan of having arc lights at every corner or at alternate ones. It would, therefore, seem worthy of a great deal more attention than it has heretofore received, and while it may not be universally adaptable, still for most places a street hood incandescent method should give the most desirable and effective illumination.

I have mentioned just three instances—the show-window, the residence and the street. There are many other places where a little thought will show that we are squandering a good deal of energy in order to produce an offensive glare while the incidental illumination could be much more agreeably produced by scattered lights of lower candlepower. In the case of the show-window we can cover the lights so as to hide them from view altogether. There are some cases of store or room lighting where we could do the same to advantage; but for street lighting it is entirely out of the question. However we can always use opal, ground glass or tinted shades over the lamps so as to dim the glare, and we can reduce the candlepower of our units so as to still further cut down the dazzling Then when we increase the number of the lights and scatter them more widely we can get the one effect which we are seeking in each case: not an exhibition of intense and glaring lights whose dazzling power is enhanced by the deep shadows which they produce, but an illumination really worthy of the name.

ELECTRIC LIGHT AND POWER FROM GARBAGE CREMATORIES.

BY MAURICE BARNETT.

Since the publication of Mr. Charles Jones' book on "Refuse Destructors" a great deal of thought has been bestowed on the question of the incineration of refuse; not only on account of the great value possessed by this sanitary method of garbage disposal, but because of the economic possibilities that attend the utilization of the calorific value of garbage as fuel. From the fifty destructors mentioned by Mr. Jones, consuming daily from three and a half to ten tons of garbage, there is obtained on an average from five to seven horse-power per cell in the destructor.

Up to within a year or so, the steam raising powers of these crematories were utilized only in connection with such industries as stone breakers and mortar mills, or, as subsidiary to electric lighting stations, to carry the day load.

It ought to be stated at the outset that garbage crematories as steam raisers have a very limited range. From the nature of the material burned one would rightly surmise that its calorific value as fuel would be small. A large percentage of the weight of refuse is moisture, in expelling which considerable heat is lost. Then again the presence of non-carbonaceous matter, as ash bin refuse, detracts from the calorific value. So that while crematories running on this fuel may be counted on to furnish a certain amount of power continuously, they are not susceptible of being "driven" unless additional fuel is burned on the grates. This explains the circumstance that up to the present, garbage crematories have only been used under conditions where the load has been comparatively uniform during the entire day, as in the instances mentioned above.

In an interesting paper read before the Northern Society of Electrical Engineers, Manchester, England, December 10th, 1894, Mr. Alfred H. Gibbings emphasized the value of some method of storage in connection with power plants deriving their energy from garbage furnaces. The special form of storage advocated by Mr. Gibbings was that of accumulators, and he proposed using the stored up energy for tram car traction. At that time the Corporation of Hull was running an electric light station, the profits of which, so far as the day load was concerned, were very small. Mr. Gibbings showed that if the garbage crematories then operated by the same municipality should be used in connection with a low tension electric plant to charge accumulators for traction purposes, and the main lighting plant be utilized during the day time to augment the output of the former, not only would the crematories be revenue producing, but a handsome profit would result from the day load of the lighting plant. Apart, however, from the question of profits, emphasis was laid upon the necessity of some method of storage which would give to crematories the ability to respond to a wider demand for power than they had been capable of up to that time.

This idea has been very completely carried out by the vestry of St. Leonard, Shoreditch, in London. As far back as 1892 the vestry had in view the erection of a central electric lighting sta-

tion and a garbage crematory. Upon the advice of their engineer the two plants were combined. In order to have sufficient power to tide the lighting plant over the hours of heavy load, it was decided to adopt the patented thermal storage system of Mr. Druitt Halpin. From a paper read last year before the Hull Congress of the British Institute of Public Health it is learned that the storage system consists of seven reservoirs, each thirty-five feet in length and eight feet in diameter. These are connected to the boilers and accumulate the energy developed but not used during those portions of the day when the number of lights in service is comparatively small.

What is of great interest and importance is the fact that this combined plant of garbage crematories and storage system is being installed by a firm of standing under a guarantee—in which there are heavy penalties for failure—that the apparatus in question will produce 100,000 lbs. of steam in 24 hours, by the combustion of the refuse without the use of coal or additional fuel.

Considering now that England has at the present time over a hundred "destructors" at work, many of which are furnishing power for industrial establishments, at a cost considerabiy less than the same power would cost if obtained from coal, it is pertinant to inquire what Americans have been doing in this line. The writer having looked carefully over the files of the engineering journals and having made inquiries at the offices of companies engaged in erecting garbage furnaces, cannot find a single instance in this country where the calorific value of garbage as fuel has been utilized for steam raising purposes.

Some explanation of this is afforded by a peculiar impression existing on this side of the Atlantic. In the prospectus of the Eagle Sanitary & Cremation Co., this statement is made: that ash bin waste here, "does not contain so large a proportion of combustible matter because of the greater amount of clinkers and slate remaining from the imperfect combustion of anthracite coal which produces a coarser ash and far less burnable residuum than does the soft bituminous English coal." While this is true, the statement has force only in localities where anthracite coal is used. Statistics, taken from the Mineral Industry, show that in 1894 the production of bituminous coal in the United States was one hundred and eighteen million (118,000,000) tons as against fifty-two million (52,000,000) tons of anthracite coal, so that there is left quite a large area where the conditions are as favorable as in England for the utilization of ash bin refuse as fuel.

It would seem, with "destructors" in successful operation abroad, with conditions as favorable here as elsewhere, with many municipalities owning their own electric light plants, and lastly with a strong popular feeling in favor of the sanitary combustion of refuse, as if there were strong reasons why this matter of crematories operated in conjunction with industrial lighting plants should be taken up here as it has been in England. It was with surprise that the writer learned that there were no such combined plants here, and could only explain this on the assumption that sanitary cremation companies were not fully alive to what was accomplished with different forms of storage apparatus.

Of the various forms of storage, as steam storage, feed storage, combined feed and steam storage, and storage batteries, the last both on theoretical and practical grounds would seem to be the best "because of its forming the last link in the chain, thereby giving the economies of continuous working to all that precede." The basis for this statement is the fact that storage batteries are cheaper in first cost than the equivalent steam power plant which they would replace, have a wider range of power and are more economical in operation than other forms of storage apparatus.

It is to be hoped that municipalities having or contemplating the establishment of their own lighting plants will seriously consider the question of combining their lighting stations with some well equipped garbage crematory supplied with efficient storage apparatus. Besides having a sanitary method of disposing of their refuse, they would find that their lighting plant could be operated cheaper than without the crematory adjunct, while the storage apparatus besides enabling them to use the heat going to waste the greater part of the day and night, when there is not a large demand for power, would give a wide range of power to the lighting station, enabling it to respond to the fluctuations of load incidental to electric lighting and save the generating machinery from the strains to which it would otherwise be subject,

A POLE WAR AT MARTIN'S FERRY, W. VA.

A special dispatch from Wheeling, W. Va., of Dec. 1, says:— Several hundred Bridgeport and Martin's Ferry people fought to-night. The Bridgeport Electric Light Company was ordered by the Martin's Ferry City Council to take its poles off Martin's Ferry streets. The time given the company expired this morning, and about 1,000 Martin's Ferry people armed themselves with axes and chopped all the poles down, the work extending until late in the afternoon. Many Bridgeport people attempted to prevent the work of destruction. The greatest excitement prevailed in the two towns throughout the day. It being Sunday, no injunction could be secured against Martin's Ferry inhabitants.

PRIZE OFFERED FOR A FUSE DESIGN.

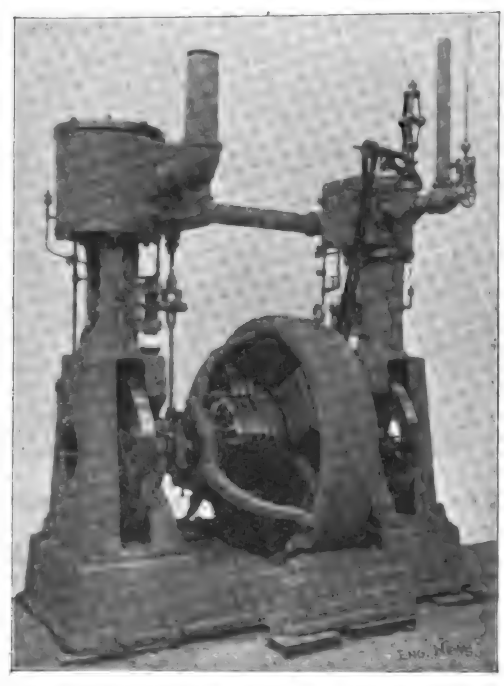
The Verband Deutscher Elektrotechniker is offering a prize, consisting of a diploma and $75, for the best device by which mistakes, such as placing the wrong size fuse in fuse terminals and the interchanging of fuses except by authorized persons, shall be rendered impossible. The standard sizes of lead fuses adopted by the Verband at its last annual meeting are to be employed. These are:—

Amperes.	Distance between centres of fuse terminals in inches.	Diameter of terminal screw in inch.
50	2 8	[illegible]
100	3.2	$\frac{5}{16}$
400	3.8	[illegible]
1,000	4 4	[illegible]

The designs are to remain in every respect the property of the individual, and must be sent in not later than April 1, 1896, addressed to the Verband at 3 Monbijouplatz, Berlin, N., and marked with a motto. The result will be made public at the next annual meeting of the Verband.

THE LANE & BODLEY THROTTLING COMPOUND ENGINE FOR LIGHTING AT ATLANTA.

The accompanying illustration shows an interesting form of compound engine for electric lighting purposes, which is exhibited at the Atlanta Exposition by the Lane & Bodley Co., of Cincinnati. It consists of two vertical engines of ordinary form, set on one bed plate, with the electric generator between them, the engine shaft carrying the armature of the generator. Both engines have ordinary slide valves, and the smaller one is fitted with a Pickering throttling governor. The engine is run non-condensing, and it is claimed that, for a non-condensing engine running under variable loads, the throttling governor gives a higher economy of steam than the automatic cut-off governor. With the latter, when running with light loads, the steam being cut off very early in the high-pressure cylinder, initial condensation causes a loss of



LANE & BODLEY THROTTLING COMPOUND ENGINE.

steam, and in the low-pressure cylinder expansion is carried below the atmosphere, making a loop in the indicator diagram, which shows a loss of useful work. These disadvantages are avoided in the compound throttling engine, in which the cut-off is constant. In the engine at the Exposition the cylinders are 10 and 16 ins. diam., and 12 ins. stroke. At a speed of 275 revolutions per minute, and a steam pressure at the stop valve of 115 lbs., the engine is rated at 90 H. P. Special features of the engine are the fly-wheel cranks, shown in the cut, and the means provided for easy removal of the crank-shaft, with its flywheels and the electric generator, from the frame of the engine, for inspection and repairs. The main pillow blocks are contained in recesses in the inner sides of the upright frames, and the two covers being removed, and the two connecting rods uncoupled, either at the

crank or the wrist pin, the crank shaft, generator, etc., can be lifted out by means of the ring bolt shown in the casing of the generator. The electric generator used with the engine was built by the Card Electric Motor & Dynamo Co., of Cincinnati, O. It is a six-pole, direct-current machine, rated at 125 volts and 400 amperes, or 50 kilowatts, capacity. We are indebted to *The Engineering News* for the accompanying engraving.

TELEPHONY AND TELEGRAPHY.

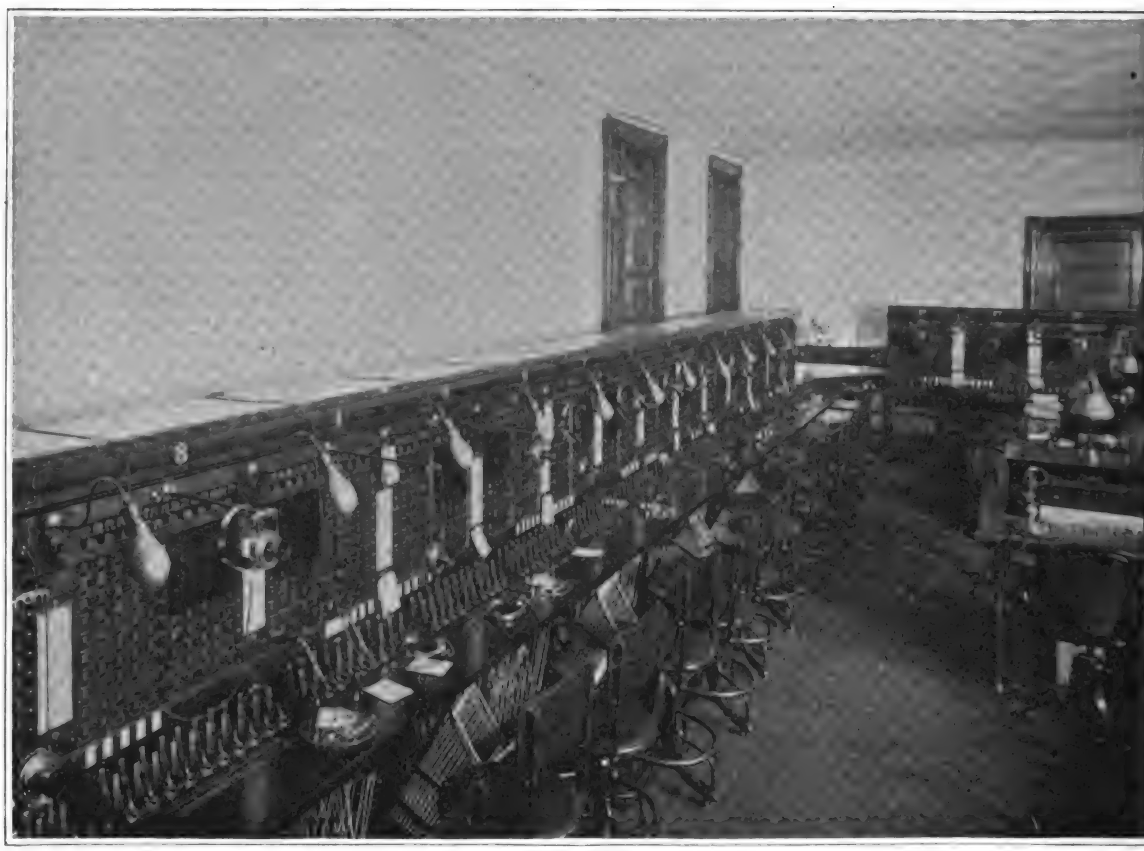
THE CALCULAGRAPH IN TELEPHONE AND TELEGRAPH SERVICE.

THERE is no system of communication in which personal annoyance is so easily engendered by the slightest delays as is the case in telephony. A man may be ever so anxious to get off a telegram, but once it is deposited in the hands of the messenger boy or at the receiving window of the telegraph office, his worry ceases, though the message may be fifteen minutes or more before it reaches the operator for transmission. A delay of fifteen seconds, on the contrary, to the average man with a telephone at his ear, constitutes a most annoying delay, and not infrequently gives rise to the lodging of a complaint. In exchanges doing extra-territorial business or in which toll rate is charged instead of a flat subscription rate, each subscriber's call must be recorded. This requires time, and even the short delay is apt to give rise to complaints. The conditions just mentioned prevail pre-eminently in the case of the business done by the Long Distance Telephone Company, which is exclusively on the toll system. In keeping with the progressive spirit which has characterized all work of this Company from the beginning, every possible means for shortening the time between the ring-up of the calling subscriber and the beginning of conversation with his correspondent has been applied, and the most recent of these is the introduction in most of the large offices of the Company of what is known as the "Calculagraph," which performs a variety of functions heretofore requiring time and manual labor on the part of the operators and the adoption of which has resulted in the marked gain in the efficiency of the office.

In order to understand the working of the calculagraph we may take, for instance, the system of recording in use in the New York office of the Long Distance Company. The calls for long distance wires are received as usual at any of the local exchanges, and then transmitted to the Long Distance Exchange in Cortlandt St. being there received first upon what is called the recording board which receives the calls from fourteen exchanges through trunk wires. In addition to this the board also receives calls direct from 200 Long Distance wires, which have no local connections whatever.

The operator at this board records each call on a card check. As soon as the call is received, she disconnects the trunk at the local exchange. The check is then inserted in the calculagraph and, by the slight movement of a handle, is stamped with the time. The object of this is to afford means for tracing the time which has elapsed between the receipt of the call at the recording board and its delivery into the hands of the operator at the toll line board. This having been done, the card check is brought over to the toll line section and the operator passes the call, let us say to Boston, for example, and receives a reply as to whether the person called is in or not, the answer being noted on the card. When the two parties have actually begun talking, the ticket is again inserted in a calculagraph, placed beside each operator, and by pressing down the lever at the right, the time is stamped on the ticket indicating the actual commencement of conversation. This constitutes the second use of the calculagraph.

If it should happen that the wire be noisy or defective in other ways, after conversation has begun, the time *elapsed* during the interruption between the changing over from the poor wire to the good one, is indicated on the back of the card check and the calling parties are given credit for the time interrupted. Finally, after the conversation has closed the ticket is again stamped by pressing the lever on the left hand side, which records the total actual time elapsed in minutes and quarter minutes.



THE CALCULAGRAPH AS MOUNTED ON THE SWITCHBOARD OF THE LONG DISTANCE TELEPHONE EXCHANGE, NEW YORK.

Our engraving, Fig. 1, shows a part of the toll board installed in the operating room of the Long Distance Company at 18 Cortlandt Street, New York City. Each operator is supplied with the calculagraph, which is let into the horizontal board directly in front of the listening keys.

The calculagraph consists essentially of a clock movement, operating a time stamp. This stamp consists of a dial, on which are marked the hours of the day, and moving with it, but capable of being operated independently, is an arrow. To explain its use, let us take the case of a telephone message for example. At the beginning of a message the ticket is inserted in the slot at the front of the instrument against a guide and the right hand lever is then pushed backward and forward. The first movement records the time of day by the dial, while the second movement makes an impression of the two dials only, shown at the left in Fig. 2, but makes no impression of the pointers. At the end of the

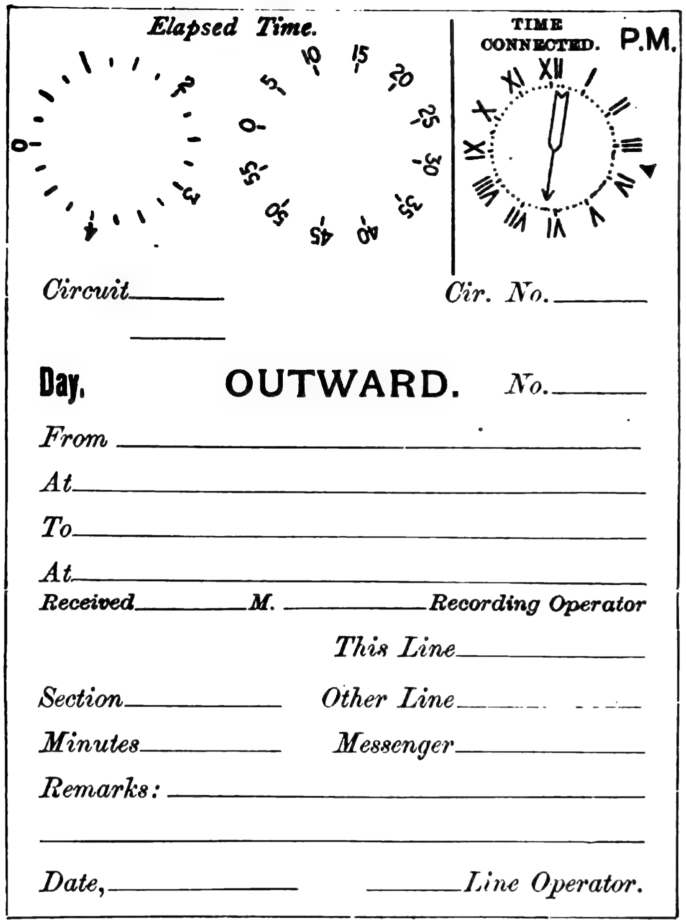


FIG. 2.

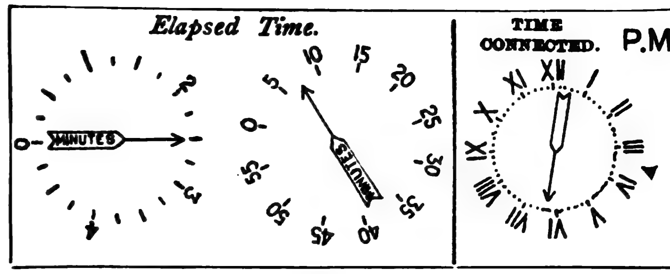


FIG. 3.

FIG. 6.—THE CALCULAGRAPH.

message the ticket is again inserted in the slot, automatically coming in the same position as before, and the left hand lever is then pulled forward. This operates only the two pointers, which print in the centre of the two left hand dials and point towards the figures which represent the exact length of time which has elapsed since the first impression was made, as in Fig. 3. This record shows that the connection was completed at 8:32 P. M. and the time which elapsed during the talk was 7½ minutes.

Fifteen of these stamps are in use in the New York office of the Long Distance Company. Calculagraphs have also been

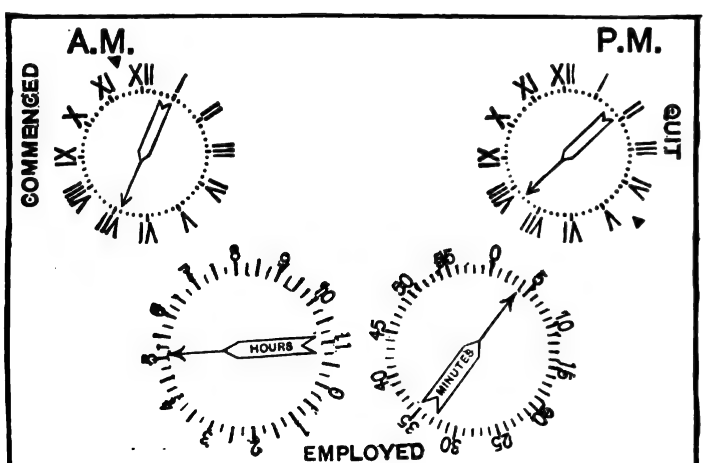


FIG. 4.

installed in the offices of the Company in Boston, Providence, Springfield, Troy, Philadelphia, Pittsburg, Buffalo and Chicago. Being entirely automatic in its action, clerical errors due to the inattention of the operators are, of course, entirely eliminated. This, together with the actual saving in time effected by their use, together with the curtailing of the work of the operator, and consequent relief from mental strain, has markedly increased the efficiency of the service.

It is evident that the principle embodied in the calculagraph is adapted to a great variety of uses. Thus, its employment in all classes of races and other sports is obvious, as is also its use in every situation where labor is employed and paid for by the hour, or to record the running time of street cars, etc. It is also obvious that by merely changing the figures of the dial from hours and minutes to dollars and cents, the calculagraph becomes a dollar and cent instrument, printing the actual money value of the time elapsed. The record at once becomes a voucher for the pay roll of workmen, and thus serves a double purpose. This

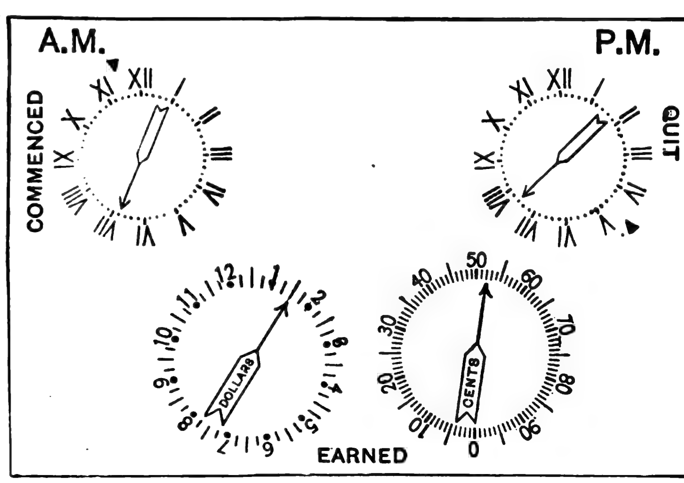


FIG. 5.

instrument, employed in District Messenger offices, can be used to print upon the ticket which the messenger carries the amount to be paid for his services. The same instrument of course could be employed to record the earnings of electric boats which are rented by the hour, or for any other apparatus which is rented for a stated period.

Our illustration, Fig. 4, shows a specimen record of a workman's ticket made by the calculagraph, which indicates not only

the time of starting and quitting, but also the number of hours and minutes employed. Fig. 5 shows a specimen record of the calculagraph in which the amount earned by the same workman is indicated in dollars and cents by the apparatus, at the rate of thirty cents per hour.

The instrument is 8½ inches in diameter, and 5 inches high. It is built by the Calculagraph Co., of New York, in two styles; the portable form shown in Fig. 6, the other being arranged so that it can be let into a table or mounted on a pedestal. The clock contained in the calculagraph runs eight days, and has a visible dial.

NOVEMBER BELL TELEPHONE OUTPUT.

The Bell Telephone Company makes a good instrument showing for the month ended Nov. 20, coming within 36 instruments of September, which was the largest on record. Compared with a year ago, the gross gain was 8,624, and the net 8,984. Below are the comparative statistics for the month and eleven months:

Month Nov. 20.	1895.	1894.	Increase.
Shipments	18.439	9.815	8.624
Returned	6,142	6.502	*360
Net output	12.297	3,313	8,984
Since Dec. 20.	1894-95.	1893-94.	
Shipments	161,631	81,021	80,610
Returned	73,957	65.630	8,327
Net output	87,674	15.391	72,283
Total in use	670,180	581.882	88,298

*Decrease.

LITERATURE.

Poor's Directory of Railway Officials. 1895. Compiled from officiali nformation. Poor's Railroad Manual. New York. Cloth. 8vo. 616 pages.

This is the latest issue of a manual which for ten years past has proven itself to be very useful and entirely trustworthy. It gives the names of about 7,500 steam railroad officials, and supplements this by a mass of valuable data on mileage and equipment; operation figures; dividends, meetings and transfer agencies, &c. An equal amount of information is given about the officials of American street railways, supplemented by that as to Canada, Mexico, &c. The introduction discusses intelligently the growth of electric traction. With this goes an array of figures of great interest summing up the mileage, investment, &c. of the industry. It is shown that the total length of the street railway lines in the United States is 13,176 miles. Of this total, 409 miles are operated with steam dummies, 10,238 by electric power, 578 by cable, and 1,950 by animal traction. Such returns as have been received show an equipment of 30,857 passenger cars, 12,563 motor cars, 2,607 dummies, and 45,858 horses. The rapid substitution of electric traction for animal power may be judged by the fact that since 1891 the number of horses employed in the street railway service has declined nearly 145,000, or about 71 per cent.

The capitalization of 12,797 miles of street railroads from which reports have been received aggregates $520,745,823 stock and $367,694,477 bonds, an average of $40,691 per mile of stock and $28,333 per mile of bonds, equal in the aggregate to $69,024 per mile of stock and bonds, against $56,611 per mile for steam railroads. In view of the still rapid growth and the large floating debts that some of the roads have had, still unfunded, it will be seen that even these enormous figures of capitalization are an understatement of the gigantic growth and speculation. It is a marvel that so much of the property capitalized should have proved as fairly capable as it has done of earning dividends.

LETTERS TO THE EDITOR.

DATA SHEET SUGGESTIONS.

With each issue of the Data Sheets I eagerly look for the "Expanded Classification," but I am sorry to say that I have thus far suffered disappointment. With many others I join in the hope that you will bring it out very shortly.

As the ease with which one can run over the sheets, when in quest for a particular number, materially enhances the value of the data, and as to this end an exact uniform size when cut up, is necessary, I would suggest that you could issue, with profit to all concerned, a standard metal template to be placed on the rectangles as a guide for the knife in cutting the same. I have made such a template and the results are excellent.

E. H. Dewson, Jr.

Quincy, Mass.

In reply to our correspondent and to numerous others who have addressed us on the same subject we will say that we propose in the very near future to publish a complete extended index to the Data Sheets which will contain several hundred subject headings. The present index was never intended to be final but it was deemed inexpedient to publish the complete index before the work we had in mind was fairly well under way and the form of the Data Sheets had crystallized into definite shape. The new index will serve not only as an index to the Data Sheets but will, we hope, enable our readers to properly classify all their electrical notes and memoranda in a manner which will enable them at once to find any particular item without fail in the shortest possible time.

The suggestion with regard to the template for cutting the sheets is thankfully received and will be stored up with a number of others for future use.—Eds. E. E.

ANALYZING THE FIGURES OF THE DETROIT MUNICIPAL PLANT.

With reference to your editorial of the 27th on Detroit lighting figures, and with reference also to a letter already sent you concerning an editorial of the 20th: I wish to furnish some information further to the figures which you publish and comment upon, the information being of such a character as to assist you in your deductions and possibly to modify the same.

You write that "there is no mention of three big items, to say nothing of smaller ones." To take the three big items seriatim. You say, first, "There is no allowance for depreciation." I am familiar with the practice of many private lighting companies and I know that very few of them make any allowance for depreciation. They make their repairs and improvements from year to year; they keep their lines, buildings and machinery up to the first valuation, and if the annual inventory, conservatively taken, shows no depreciation in the assets of the concern, they do not trouble to write off a theoretical depreciation. This being the practice of many private concerns in the best standing, why should it not be admissible for a municipality? Then, if it is admissible, it is easy to show that the omission of the specific depreciation charge from the Detroit accounts does not prevent their comparison with those of private concerns, because maintenance work, much of it of an expensive class, has been done and will continue to be done every month under a fixed policy to keep up the value of the investment.

You must note further, that a large portion of the Detroit investment is in real estate, which is *appreciating* in value instead of depreciating; and that more of it is in such substantials as buildings of the most solid class, railroad track, dock, underground conduits of tile and concrete, and iron towers and lamp posts. Even on the pole lines the depreciation charge will be small because the rentals received for the use of the city poles by private concerns will help materially towards meeting the cost of rebuilding.

Secondly: "There is apparently no charge for water." Because the Lighting Commission invested two thousand dollars, in a permanent connection with the Detroit River, and no one, so far, has presented a bill for the abstraction of water from that international highway.

Thirdly: The taxation of the private company was reduced on account of the wiping out of its investment in public lighting lines, etc., which reduction, if spread over the number of arc lights operated by the city would amount to exactly 15¾ cents per light per month, which figure you may add to the other.

Moreover, there is no allowance for rent of offices because part of the capital was invested in a first class building for use as offices, repair shops and stores. This last is the only one of the "smaller items" which you mention, and I won't try to imagine the others. They probably admit of the same kind of an answer.

Your last conclusion, "That Detroit is absolutely without provision for contingencies or extension" is not quite correct. Extensions can be made at comparatively small cost, because floor space, boiler capacity and main transmission lines have been provided for extensions. The particular extension, which is the text of your comment, is one which will certainly be made if it appears to be a good investment and will not be made if it does not appear to be a good investment. The position of the municipality in a case of this kind is very much better than that of a private contractor obliged to furnish light anywhere within the city limits on an order from the City Council whether he can do so or not with a fair return for his investment in lines and apparatus; and the manner in which the question is being considered and dealt with is, if anything, an illustration of the desirability of municipal ownership. The Lighting Commission cannot be compelled to invest a lot of public money in unprofitable extensions. Does it occur to you that many private contractors have paid out more to reach new lights than they have gained by the rentals of those lights? When the ordering of a new light means the provision of money for the construction of the connection as well as the payment of the cost of operation, new lights are not likely to be ordered until they are really needed.

You conclude, "We must confess we do not see where the superior cheapness of the Detroit lighting comes in." The citizens of Detroit can see this very readily *as regards their own particular*

case: any other case must stand on its own bottom. I confess I do not see myself that there is anything miraculous in the Detroit figures. They do not pretend to be anything that they are not, and they are exactly what may be expected from any plant, whether municipal or otherwise, that is fairly well designed, honestly built, and operated in a manner neither niggardly on the one hand nor extravagant on the other.

Respectfully,
ALEX. DOW,
Engineer Detroit Public Lighting Commission.

DETROIT, MICH., Nov. 29, 1895.

CAPITAL WANTED FOR A SOUTHERN ROAD.

I have for a long time advocated the building of an electric line from Charleston to Summerville, S. C., a distance of 23 miles, which I am sure would prove a very profitable investment, but I have never contemplated making such a move myself, although I would be glad to become interested.

If you know of any capitalists likely to become interested in building an electric line from Charleston to Summerville, I would be very glad if you would put them in communication with me.

F. W. WAGENER.

CHARLESTON, S. C.

SOCIETY AND CLUB NOTES.

ANNUAL MEETING OF AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

The annual meeting of the American Society of Mechanical Engineers was held at headquarters in this city last week, when there was a large attendance and a number of interesting papers were read.

DR. C. E. EMERY read two papers. In the first entitled, "Means Adopted for Saving Fuel in a Large Oil Refinery," he describes the economy effected by consolidating the scattered steam plants of the Tidewater Oil Co., at Bayonne, N. J., the coal consumption being reduced more than one-half. Regarding the application of electric power distribution in this plant Dr. Emery says:

The question may be asked why it was decided to give up the electric-power system. The principal reason was that it was quite expensive, and, moreover, not warranted by a balance of the advantages for a location where much of the exhaust steam could be used for heating purposes. Even if interest on first cost were neglected, the quantity of exhaust steam which could be utilized for heating purposes would be many times as much as the steam required to operate the dynamos. This last steam had to be supplied as well as the first, and, if supplied through steam engines, the power could be developed with only the extra cost due to heat lost in the performance of work, which is comparatively trifling in such a place, and the heat lost by radiation during transmission. So long as the heat lost by radiation was less than the cost of the power in the best compound engines, the use of the latter was not warranted even on economical considerations, and when the cost of the electric plant was considered, the balance was decidedly in favor of the plan finally decided upon. It does not follow that this decision would apply as a general rule. Every case must be decided on its own merits, but in making such decision great pains must be taken to obtain the probable results in practice rather than those which have been shown under experimental conditions. The small electric transmission plant previously referred to is now in operation. It is a three-phase alternating system, put in by the General Electric Company. A 75 kilowatt 550-volt generator is provided, it having been decided on consultation to make it large enough to furnish all the incandescent lights then supplied from three small plants in different parts of the yard. There are about 60 horse-power of motors distributed at outlying points, the units varying from 5 to 30 horse-power. The electric conductors displace about 2,000 feet of steam pipe of various sizes which it was necessary to keep hot winter and summer. In locations where gases exist that a spark would light, the variable starting resistance has been omitted from the motors and the switch-blades are immersed in oil, so that the electric apparatus is absolutely sparkless. The change has improved the electric lighting, and the motors are also operating quite satisfactorily.

DR. EMERY's second paper was entitled "Tests of Steam Boilers with Different Kinds of Coal." He shows that the difficulties in comparing the results of tests with steam boilers are very much reduced if such tests are made with the better grades of anthracite or semi-bituminous coals ordinarily sold in the market, as the difference in results between the same is, as shown by the elaborate Isherwood experiments, very small. He points out that the practical evaporations are not accurately proportioned to the calorific values shown by calorimeter or chemical composition, but they can be compared with a fair degree of accuracy by stating the results in units of evaporation per pound of combustible. It does not appear, everything considered, that for tests of different boilers with different coals of the same general character, any other plan will give results any more accurate.

The paper by MR. SAMUEL WEBBER, on "Water Power—Its Generation and Transmission," gives the history of the most prominent application of water powers in the United States, and of the various water wheels in use. It also touches on the cost of developing water powers.

In his paper on the "Experimental Method of Determining the Effective Centre of the Light Emitted from a Standard Photometric Burner," PROF. D. S. JACOBUS, gives a formula for calculating the desired quantity. In the Sugg Argand gas burner fitted with an Edgerton screen, the results of experiments showed that the effective light centre of the burner was about $\frac{1}{10}$ths of an inch from the geometrical centre of the flame, and entirely outside the flame.

The paper on "Tests of a 10 H. P. De Laval Steam Turbine," by W. F. M. GOSS, showed that the engine at a little more than its rated power consumed 47.8 lbs. of steam per brake horse power hour. The efficiency of the engine falls off rapidly as the load is decreased. Tests were also made of the starting power. With all nozzles, at 125 lbs. steam pressure, the maximum starting power was equal to a force of 30 lbs. acting at a radius of 1 foot.

"Some Experiments with the Throttling Calorimeter" was the title of a paper read by MESSRS. A. A. GOUBERT and E. H. PEABODY in which the authors give the records of some experiments made to throw some light on discrepancies arising in the use of throttling calorimeters.

NATIONAL ELECTRIC LIGHT ASSOCIATION.

Mr. Geo. F. Porter, secretary of the National Electric Light Association, informs us that the executive committee has selected Tuesday, Wednesday and Thursday, May 5, 6 and 7, 1896, as the time for holding the next, and Nineteenth, Convention; and the Industrial Building, Forty-third street and Lexington avenue, this city, as the place. The electrical exhibition at the same place is to begin on May 4 and run through the month.

NEW YORK ELECTRICAL SOCIETY.

A meeting of the New York Electrical Society will be held at the "Marble Church," 29th street and Fifth avenue, on Thursday, December 12, at 8 p. m., when Mr. George G. Wacker, the well-known organ builder, will deliver a lecture accompanied by instrumental illustrations, on the subject of "Electricity in Organ Playing." The lecture will touch on the following points: (1) a. The electric action—historical sketch; b. Different constructions of electro magnets; c. An organ action; its functions; d. The pneumatic lever; a relay; e. Electric action up to date. (2) Antiphonal effects possible; illustrated by appropriate selections. (3) Flexibility and promptness; illustrated by appropriate selections; "Largo," "Andante," "Allegro," "Capriccio." Mr. Wacker will be assisted by Mr. R. T. Percy, the organist of the church, who, by the kind permission of the rector, the Rev. Dr. Burrell, will play the illustrative selections, and also one or two pieces, including the overture from "William Tell," which will demonstrate the perfection attained, through the aid of electricity, in performing on separate and distant instruments from one keyboard. Members are invited to bring ladies with them.

PROF. A. E. DOLBEAR will lecture on Dec. 14 before the Electrical Section of the Franklin Institute on "Mechanical Conceptions of Electrical Phenomena."

PROF. F. B. CROCKER, of Columbia College, will lecture on Dec. 13 before the Henry Electrical Club on "Methods of Driving Dynamos."

MR. HARRY E. DEY, of the Dey-Griswold Electric Co., will deliver a lecture on Dec. 17 before the Brooklyn Electrical Society, on the subject of "Hydraulic Gearing as Applied to Electric Motors."

OBITUARY.

THOMAS McCOUBRAY.

We regret to announce the death of Mr. T. McCoubray, well known in electrical circles. He was born in the District of Columbia, May 20, 1847, of Scotch-Irish stock on both sides. He spent his youth in Baltimore, Md., and graduated from Baltimore City College. He was a prominent Free Mason, being five times elected Master of St. Johns Lodge, and twice elected High Priest of St. Johns Chapter. He was Eminent Commander of Baltimore Commandery No. 2 K. T.; served as Grand Inspector (or D. D. G. M.) for one term; was one of the organizers and the first Grand Potentate of Boumi Temple, A. A. O. H. N. S.; was a 33d degree mason of the A. A. Scottish Rite, holding offices in each of the bodies, and was secretary of the board of relief. At one time Mr. McCoubray served as Secretary of the National Electric Light Association. He held several positions of trust on the commercial side of electrical interests. Of late, he gave his attention to the development of an Auto-Telephone system, which has already been introduced in several places.

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CONTENTS.

TRACTION IN NEW YORK.

THE past week has been enlivened in New York, for those who have to do with traction matters, by the appearance before the Assembly Committee on Railways, sitting here, of President Vreeland, of the Metropolitan Traction Co.; Mr. Edward Lauterbach, representing the Third Avenue surface system; and Mr. George J. Gould, president of the Manhattan Elevated Railroad Company. To these were added Dr. A. Shaw, who has made an investigation of the transit facilities of European cities, and has views on the subject, which if not those of an "expert," are entitled to some consideration as being those of an unusually intelligent observer. The testimony of these gentlemen was interesting, even if it did not contribute much to the sum of knowledge already to be found in statistical records, official reports, and familiar public documents.

The best yield of such an investigation is the light it throws on the attitude of the men burdened with heavy responsibilities towards the existing state of affairs. So far as electricity is concerned, it is highly encouraging and satisfactory to find both Mr. Vreeland and Mr. Gould strongly in favor of electricity. But while the Manhattan Elevated talks, the Metropolitan Traction acts, and the result is that one is losing business while the other is fast picking it up. Mr. Vreeland went so far as to state that if the Lenox Avenue line stands the winter, the whole of the vast system will be speedily "sub trolleyed." Mr. Gould is still investigating, as though electric cars in this country were not daily carrying with safety and at a higher rate of speed, the number many times over of passengers transported by his dusty and fusty service. The delay in making the change on the elevated is not because electricity cannot easily do the work, but because the management lacks the high courage, and keen foresight of Cyrus Field, which made the elevated system an actuality. One sighs for a day of Cyrus Field.

So far as we can gather, even after the hearing given the Rapid Transit Commissioners on Friday, nobody expects the underground electric road yet awhile. Mr. Gould admitted its engineering feasibility but doubted its financiering possibility, which, after all, is about the only serious point that is uncertain. The Commission is not a unit as to city ownership, although satisfied that an electric road is wholly feasible. Indeed, its prevalent idea seemed to be that it would not be amiss to grant some further concessions to the Elevated road. Dr. Shaw also did not appear to have the strong opinions that might have been expected in favor of city ownership, though he naturally attached a high value to the franchises; as bearing on which point it may be well to note Mr. Gould's statement that for a long time the Elevated Company thought of throwing up its Ninth Avenue line, now doing so large a business, because it was a heavy loss. As things are, the Manhattan system is barely paying 6 per cent. on its $30,000,000.

This brings us to the point made with great clearness, terseness and vigor by Mr. Lauterbach, that the outcry about watered stock and the value of franchises is often without justice. None but those who have tried to win the approval of the public and of capital for new schemes of transit, realize how hopeless the task often is, and how large the inducement must be made in some shape or other

before capital overcomes its timidity and ventures in. No way of changing this condition of things has ever been found that we know of; and it will probably remain unchanged to the end of the chapter. It is easier to get capital for something guaranteed by a city, but then there must be increased taxation, with its various leakages; and there is no valid evidence that the public is any better off for that process of supplying some of its wants. As for the term "water," it may be remarked that while many enterprises are burdened with inflated values, to their own curse, the idea is wrongly made to cover many assets of real but intangible worth which help make up the property. We are glad that Mr. Lauterbach was so free in his utterances on the subject. Nothing is lost by a fuller acquaintance on all sides, with the questions and elements involved in the creation, up building, maintenance and renewal of the great traction properties of this country, which to-day more than ever are becoming permanent and solid investments for the people of small savings who constitute so important and conservative a body in modern society. The Philadelphia roads for example have 28,000 shareholders.

NIAGARA POWER AND BUFFALO.

We are glad to note that solid progress has been made in the work, not merely of providing power at Niagara ready for use at Buffalo, but in getting Buffalo ready to take it. The long period of unnecessary delay appears to have reached its close, though, of course, by procrastinating, Buffalo has lost step in the procession of would-be customers and has had to fall in at the rear.

On the 26th of November, 1895, the Buffalo aldermen unanimously reconsidered all action theretofore taken by that Board amending the Niagara Falls power franchise, and adopted the franchise by unanimous vote in practically the form in which it came from the Joint Committee appointed by the Mayor, Board of Aldermen and Board of Councilmen, with the exception of the clause which fixed the percentage on the gross receipts at 5 per cent. As the franchise has now been adopted, the tax upon the gross receipts is fixed at 2½ per cent. and takes effect six years after the acceptance of the grant. The plans are to be presented for approval by the Board of Public Works within ninety days after the acceptance of the grant, and the first 10,000 horse power is to be ready for delivery to consumers within the city on or before June 1, 1897. The Power company has indicated that it will accept the grant within the thirty days fixed for the acceptance by the franchise. The grant contains clauses for the ample protection of life and property, and while no maximum price is fixed for the power, as was at first insisted upon by the city authorities, there is a provision that the company shall not charge any consumer a greater proportionate price or higher rate per horse power than shall have been previously charged him.

We may note in this connection with regard to the very interesting article by Mr. Dunlap, in our pages last week, that the Attorney General of the State not long since gave an opinion adverse to that plan of development, so far as the new work is concerned, on the ground that the old Canal Company was exceeding its powers in the further diversion of water by the surface canal. In fact, the language of the Attorney General may be construed to mean that the Canal Co. has no authority for its work at all. Be that as it may, a good deal has been done in years past, and the latest stage is not the least interesting, its use of a head of over 200 feet making it quite noteworthy, as well as infinitely more efficient as a utilization than the old work on the brow of the cliff. Our own objection would rest not so much on the wasteful use that the surface canal has made of the water as on the fact that the public desirous to preserve natural beauty is threatened with an endless addition to the ugly factories, and the commercial destruction of the scenery, in the Gorge between the two Suspension Bridges.

REVISING THE UNDERWRITERS' RULES.

The meeting this week of the Committee of the Underwriters' National Electrical Association, in New York, to consider a revision of the rules of the Association governing electrical installations is an indication of the constant desire of that useful body to keep abreast of the times in its work. The very fact of the necessity for such a meeting shows that the art is still to some extent in a formative state and that what was considered good enough but a short while since must give way to improved methods and better construction. As to the things that have come to stay in inside wiring work we need hardly refer to the iron armored insulated conduit. Continued use has shown this type of wire protection to be the most reliable of any thus far suggested, but that improvements in the many details of wiring installations are still possible is shown by the betterments brought about by the manufacturers of such apparatus. The Fire Underwriters will probably take the credit of having been mainly instrumental in effecting the change, and we are not disposed to deny them this meed of praise, but their meeting of this week shows that finality has not yet been reached. Up to the present time this Association has been largely guided in the adoption of its rules by the action taken by the National Electric Light Association, and, indeed, the wiring installation rules of the latter form the basis for the Fire Underwriters' National Electric Association rules; but it has been urged, and we think with much force, that the time has arrived for the Underwriters to bring to their aid directly the advice and assistance of competent electrical engineers in the determination of the questions on which their work is usually final. A contributor in this week's issue suggests a number of changes which could be advantageously made in the existing rules, but among these we consider that the most important which refers to the desirability of securing uniform interpretation of the rules in all sections of the country. The English language is sufficiently refined to express an idea in adequate terms, and the impression has long been prevalent that the variation in the rulings of different inspectors operating under the same rules is a practice for which there is no valid excuse. It has also been suggested that much vexation could be avoided by the Underwriters' Association by specifying in exact terms, and even in precise dimensions, standard forms of devices used in the placing of wire, much in the same way that the Master Car Builders, for instance, have laid out standard forms of railway material. We cannot say, however, that this idea impresses us as being the best for the industry, as it might act, to a certain extent, as a bar to the efforts of manufacturers toward constant improvement. The laying down of certain requirements, more definitely than in the past, but leaving to manufacturers the choice as to the way of attaining these ends, would, we think, best meet the needs of the case. We would draw the attention of the underwriters to the fact that it is one thing to make a rule and another thing to enforce it adequately, and at the same time intelligently, and we hope that when the revised rules are to be enforced, those entrusted with their observance will combine vigilance with that discretion which alone can inspire the contractor with confidence in the necessity for their formulation.

ELECTRIC TRANSPORTATION DEPARTMENT.

ELECTRIC TRACTION IN GREAT BRITAIN.

BY

H Scholey

The task of recording the progress of electric traction in this country would not under any circumstances be a laborious one. The total mileage of electric lines does not much exceed forty, but we are inclined to make the most of that. We formerly set much store by the opening of the City and South London and the Liverpool Elevated Railways. It was expected that the success of these lines could be used as a powerful lever for the general introduction of electric traction. They have been woking for three years and their effect has been so slight that I do not think twelve miles of lines have been opened since.

I shall not be guilty of unpatriotic conduct when I say that prejudices die hard in this country, especially when possessed by local authorities or County Councils. Retardation has been due principally to the widespread opposition to overhead wires. Engineers on this side know perfectly well that the overhead system is the only practical one and they have endeavored in season and out of season to combat the prejudices that existed. I think they have in a great measure now convinced English local authorities that overhead wires are after all neither so unsightly nor as dangerous as was imagined.

It may be said that the opposition has not lasted long enough to be serious. Be that as it may, I know for a fact that the managers of some horse lines would have readily adopted electricity long ago if they could have prevailed upon the local authorities to sanction the use of a trolley system.

Though the opening of the Bristol electric tram line, which took place a few weeks ago, may be taken as the beginning of electric traction, there will be many a tough fight when its introduction into London and other large towns is suggested.

The position taken up in this country with regard to electric traction must have been a little incomprehensible to other nations. English streets are not as a rule remarkable for beauty. Certainly I can say, without fear of contradiction, that the streets through which tramways usually run would be exceedingly difficult to spoil. I think the objection to the overhead wire was based on a vague fear that the safety of the public might be imperilled and that there might be interference with the rights of property owners. When one recalls the garbled accounts in English newspapers of accidents occurring in America, it is not difficult to account for one part of the objection.

It might have been thought that the uncompromising attitude of municipalities towards the trolley would have had the effect of fostering schemes for working tramways by means of conduit systems. But there have been singularly few suggested and none that appeared likely to succeed. Attention was rather diverted towards accumulators, but though there has been considerable experience in the use of them for traction purposes in this country it cannot be claimed at present that they have achieved unqualified success. A portion of the Birmingham Central Tramways has been worked for the past few years with different kinds of accumulators but the results, judging from an outside point of view, have not been very encouraging. It may be that some of the accumulators used on this line have not been properly treated, but the whole subject of traction by this method, in view of the present overhead work, excites little interest.

It is an undoubted fact that many British tramlines are in an unsatisfactory condition. Horses are mainly employed, and on these lines it is not uncommon for the total expenses to be within one or two per cent. of the receipts. The average cost per car mile on horse lines is about eightpence. Steam is employed on a few systems but it is not likely to be extended, for in addition to being an intolerable nuisance its cost of working is quite prohibitive. In one town its cost is as high as 15 pence per car mile, while in few places is it less than 9 pence.

Under these circumstances it is not surprising that tramway managers generally are casting about for some new form of mechanical power. The cable system is very likely to attract some adherents but it is not probable that it will be a dangerous rival to electrical methods. The use of petroleum motors for tramways has received some attention. A petroleum car was tried on the Glasgow Municipal lines a few days ago but did not receive a very lengthened trial because it caught fire and was destroyed.

Although, as I have pointed out, there are only forty miles of electric railway and tramway, a good many more are projected and already the Bristol line is becoming a useful object lesson. The Leeds Corporation, a short section of whose lines has been for sometime worked electrically, have decided on a general equipment of their somewhat extensive tramway system; the Dover Corporation has applied for Parliamentary powers to erect a complete electric tramway system, while other municipalities are closely considering the question. Besides this, however, we may expect that systems at Dublin and Coventry will be in operation in two or three weeks. We may expect that for some time progress will lie in the direction of remodeling many of the existing horse and steam lines, but the improved service that may be expected will soon show the importance of making new electric tramways.

Tramcars are not very popular vehicles in this country; for the most part, especially in the metropolis, they serve only the poorer districts, hence it is not surprising that the total mileage of tram line does not exceed a thousand. A quicker and better service, however, would do much to popularize it and I shall not be rash in prophesying that in a few years the tramway will become a valuable means of communication in the best residential localities.

It is expected here that American systems with modifications suggested by local conditions will be copied to a great extent. There is however likely to be an important difference in the form of trolley. I do not know whether the side trolley which was originated on the South Staffordshire line, used also at Bristol, appeals very much to American street railway men, but it has made a good impression here. There is no doubt that it works admirably, but how much of its success is due to the much lower speed of cars than is permitted in America is difficult to say. It obviates cross suspension and that is considered to be of paramount importance in this country. Perhaps Englishmen generally have an exaggerated idea of what the span wire system means or may be their notions are derived from some of the earlier lines.

A very important feature in the new Bristol electrical roads is the necessity of complying with the new Board of Trade regulations. Without going into unnecessary details, these regulations insist that from one end of a line to another there shall not be a greater drop in potential than 7 volts, and for every mile of track there shall be no greater leakage than $\frac{1}{100}$ of an ampere. It is obvious that if these rules can be complied with, the line must be in a very efficient state. There are many who maintain that it is impossible to avoid infractions of these rules, but at any rate the Bristol line keeps remarkably well within the restrictions, which says a good deal for the method of track bonding.

The opening of the Dublin line is being looked forward to with considerable interest by engineers, on account of the three-phase working which is involved. The line is about 8 miles long and is divided into three sections. Each of these sections is controlled by a sub-station which contains a rotary transformer deriving its current from the three-phase generating station. It was found that the adoption of this system was necessary in order to comply with the obligatory conditions of the Board of Trade.

The municipalization of tramways is spreading very fast in this country, but I do not think that fact will prevent the spread of electric traction.

Of the lines worked electrically, that are really railways, we shall very soon possess two more. The Waterloo & City Railway is nearly completed, and work is proceeding on the Central London Railway. Both these lines are underground and it is to be hoped that their success will influence the Directors of the useful but ill-conditioned Metropolitan Railway.

ELECTRICITY FOR THE ILLINOIS CENTRAL.

It is not generally known that the Illinois Central fully intended to use electricity on its World's Fair service, which was installed in May, 1893. The engineers of the road, after making a thorough examination of the various systems then in use in the United States and in Europe, reported the feasibility of the project, but it was found that the work could not be completed in time. The company then laid two new tracks and devoted them exclusively to an express service between Randolph street and the exposition grounds. The wonderful success of this service, and its popularity with the public, was not lost to the railroad officials, who saw in it a suggestion which has resulted in the establishment of a permanent suburban service.

But the company is not yet satisfied. The officials are fully alive to the fact that they are confronted with the ever-menacing competition of the electric street railroads and the prospective extension of the Alley Elevated. The situation was fully explained recently by Chief Engineer J. F. Wallace, of the Illinois Central, who said:

"Had it not been for the complications growing out of the lake front park, which has demanded so much attention at the hands of our officials, some positive action would probably have already been taken toward substituting electric equipment on our suburban service. It was fully intended to use electricity on our World's Fair service, but in the light of recent improvements in electric motors it is fortunate that the change was not made at that time. The same power and efficiency in electric motors can now be purchased for less than 25 per cent. of the prices which then prevailed.

"We are now making extensive experiments to secure exact data on which to establish and equip our suburban service on a permanent basis. Our regular suburban service now extends from Randolph street to Sixty-third, and is re-enforced by the express service which takes in South Chicago, Blue Island and stations intermediate between these points and Sixty-third street. If it is found that this system is fitted to the demands of the people along the line of our road it will be made permanent, and we shall proceed to make such changes as will result in increased efficiency and economy. We are making a careful study of the various systems now in use and when we have made the change there will be installed the finest electrical railroad on earth."

THE LOMBARD HYDRAULIC CAR BRAKE.

The question of equipping cars with power brakes instead of the old established form of hand brake is daily becoming more important, and we are glad to show in the accompanying engravings the Lombard hydraulic brake, the invention of Mr. Lombard, who is also the inventor of the well known and successful Lombard water wheel governor. This brake has been the subject of much experiment, and has now reached the stage where it is ready for the market, after having undergone a series of exhaustive tests on cars in actual practice.

Fig. 1 shows the box, which is about 30 inches long, 12 inches wide and 8 inches deep, containing the piston and pump cylinders connected with the pressure tank, which is about 38 inches long and 6 inches in diameter, the whole apparatus weighing about 150 lbs. The box may be placed anywhere under the car floor where the sprocket wheel can be connected with the axle to get

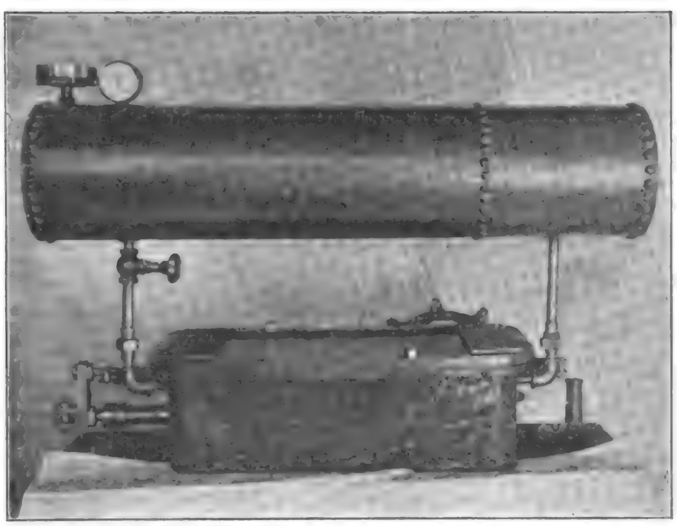


Fig. 1.—The Lombard Hydraulic Brake.

power to drive the pump. The tank may be placed anywhere that can be reached by piping to connect both sides of the same to the box containing the brake and pump cylinders, preferably under the seats of the car. This tank is partitioned into two chambers, the larger chamber is filled two-thirds full of oil and is charged with air compressed to about 220 lbs pressure. The smaller chamber is practically a vacuum. A safety valve is placed on the pressure end of the tank. The pressure gauge may be placed anywhere upon the car.

Fig. 2 shows the brake cylinder and pump arrangement of the valve operating mechanism. It will be observed that the shaft having a small crank at one part of it driven by the sprocket wheel and chain from the axle is connected to the piston rod of the pump by means of a fork connecting rod giving a reciprocating motion to the piston. The piston and valves are so arranged as to make it a single acting pump. The brake operating piston, the larger of the two having a rod projecting outside of the casing, is so arranged as to receive the brake chain coupling at A. Any movement of the piston will operate the brake lever and so set the brakes of the car. It is also connected with the valve by rod B. This piston and rod may travel 10 inches and is 2¼ inches in diameter, taking 18.84 cubic inches of oil or about one pint to fully extend the brake rod. Rod C operates the three-way valve which controls the setting or releasing of the brakes and is operated by a handle at either end of the car. Pipe connections D make a closed circuit for the fluid to pass from the pressure tank through the brake piston, setting the brake and exhausting into the vacuum. It is then pumped back into the pressure tank by a few strokes of the pump through channels in the pump castings and pipe, thus constantly maintaining the pressure and vacuum; the piping is so arranged that oil and never air enters the brake

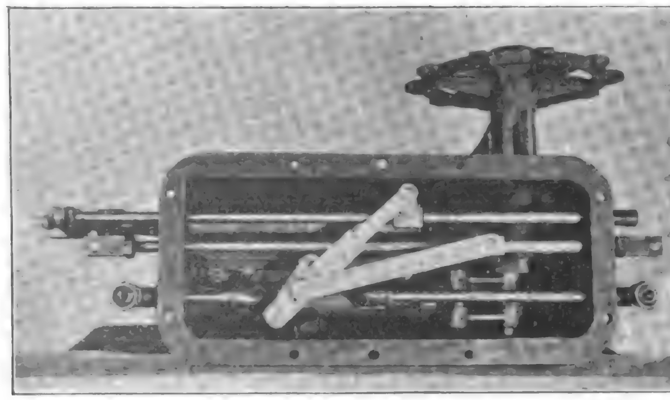


Fig. 2.—The Lombard Hydraulic Brake.

cylinder. The iron casting is partly filled with lubricating oil and closed tightly, thus continually lubricating all parts needing it.

The operation of the brake is, as follows: The power stored in this pressure tank consists of an elastic air cushion of 220 lbs. pressure and an inelastic fluid, which is in this case preferably oil; this fluid is used as a medium to transmit the stored energy of the air pressure from the tank to the brake operating piston, Fig. 2, Any movement of this piston will operate the brake lever and so set the brakes of the car.

To operate this brake piston the pipe running from the three-way valve supplies the fluid under pressure to move the piston, all in accordance with the opening of the three-way valve which may be set at will by the operator. A compensating lever mechanism, shown in Fig. 2, will set the fluid valve so that the large piston can be held at any position or part of its stroke; that is to say, the piston can be moved forward to put the stroke on light or heavy or at any point desired and hold it there. The same three-way valve also regulates the release in the same way and controls the throwing off of the brake shoes so that the brake can be held at any degree of tightness desired, and is under the entire control of the operator. As before stated, the oil is merely a medium of transmitting the power from the pressure tank to the operating brake piston and from the force pump back to the pressure tank to restore the energy consumed. In this case the pump shaft only has to make four or five revolutions to return to the pressure tank all the oil used in its operation.

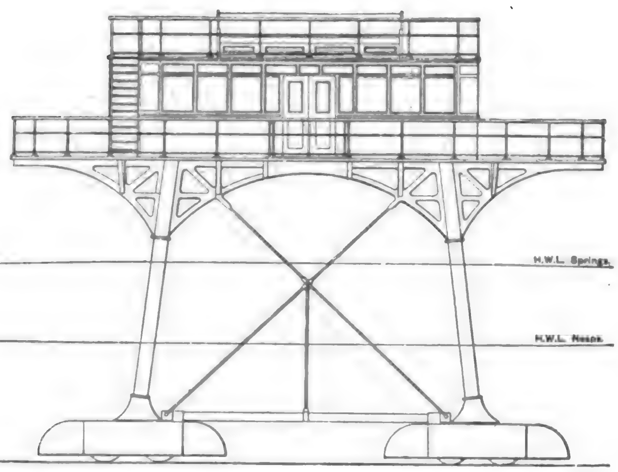
The discharge of this hydraulic brake is also worthy of consideration. It is entirely noiseless; in fact, when discharging into the vacuum tank the exhaust or discharge of the brake is instantaneous although under full control of the operator, as the least movement of the handle changes the valve and the direction of the movement of the oil.

The fact of using oil, an inelastic fluid, for transmitting the power gives several advantages to this brake. First, ease of maintaining the pressure; the compressed air does not leak out. Second, the simplicity of its operation; any man who knows enough to operate the hand brake will control the car better with this brake, on his first trip, than he can with the old brake, because the least movement of his handle is instantly answered by the quantity of oil behind the brake piston and consequently the amount of pressure of the shoes on the wheels. In going down grade he can ease off a certain amount of pressure, controlling his speed absolutely. In making a start on an up grade the same facility enables him to hold the car at just the point at which the wheels would begin to revolve, then applying the power the easy release of the brake allows the starting without a hitch or jerk. He can make the ordinary stops in about one-half the time or distance that he can by his hand brake, and make his trip in 10 per cent. better time.

The same facility to ease off his brake a little and still hold, if he sets it harder than necessary, prevents the skidding of wheels. For an emergency stop his natural way is as in ordinary stops simply to pull the handle, opening the three-way valve and the whole force is instantly applied and stays on even if the motorman jumps. The controlling rod is so placed that a collision would tend to open the valves and set the brakes. Emergency stops have been made in 6 feet.

THE BRIGHTON-ROTTINGDEAN ELECTRIC RAILWAY.[1]

THERE is something almost morbid in the mania for novel sensations exhibited by seaside resorts, or rather by those who resort to the seaside. To be suspended from a steel hawser in a sort of basket and raced through the air just out of reach of the waves, a form of amusement much affected in America, is a tolerably novel experience. At Brighton, however, Mr. Magnus Volk, if he is allowed his way, proposes something scarcely less unconventional. Mr. Volk's idea is to run the steel structure shown in the illustration below *through* the water from the far end of his well-known little electric tramway to Rottingdean, a total distance of exactly 3 miles; 4 furlongs 8 chains of which are within the jurisdiction of the Brighton Town Council. The main object of the line is doubtless to attract traffic by the novelty of running through the waves in a sort of hybrid tramcar-lifeboat conveyance. There is, however, no little justification for the tramway purely as a means of "rapid transit," as our American friends would term it, between Brighton and Rottingdean. The road is tortuous and uninteresting, and the "'bus" is slow; the proposed line is straight, and in the matter of speed and of interest should leave little to be desired. If the weather during the next six months is not altogether unpropitious, and the opposition of the Town Council is overcome without delay, it is expected that the line will be at work by June next; already all but a few hundred yards of the track has been laid.



MARINE RAILWAY CAR, BRIGHTON, ENGLAND.

The rails run along the foreshore at a distance of about 150 to 250 yards from the base of the cliff, slightly above low-water mark; at high tide they are covered by 14 feet of water. Instead of two rails connected by tie-rods, there are two *pairs* of 54 lb. rails, a distance of 18 feet intervening between the two outers. Each pair of rails (2 ft. 8½ in. gauge) is laid separately, on concrete blocks mortised to the chalk below. In 1893, when the Act was obtained, the chalk was covered in some places by a layer of sand 3 feet thick. During the storms of last winter the sand was all swept away, to be subsequently slowly silted up again. The steepest gradient is 0.3 per cent, ; the sharpest curve has a radius of half a mile.

The car, which was designed by Mr. St. George Moore, joint engineer to the Company with Mr. Volk, is being built by the Gloucester Wagon Company. It is supported by four splayed-out legs, each leg consisting of a 12 inch steel tube, running on a four-wheel bogey. The wheel base is 28 feet. Each of the two leading bogeys will be driven off vertical shafting inside the tube by a 30 H. P. vertical motor, to which current will be conveyed on the overhead trolley system at a pressure of 500 volts. The deck of the car will be 24 feet above the rails, and will measure 50 feet by 22 feet; it will carry a saloon 25 feet by 12 feet. The structure by itself will weigh 40 tons, and, with motors, gearing, and 150 passengers, the total weight will be 60 tons. The speed expected to be realized is six miles an hour.

The Brighton-Rottingdean electric line presents several exceedingly interesting electrical and mechanical problems, and engineers will wish Mr. Volk every success in his new venture.

FRANK H. SLOAN, City Surveyor of Baltimore, has received the contract for the rail work of the Columbia and Maryland electric road between Baltimore and Washington, a distance of 40 miles. He has also been made consulting engineer to the Banking and Trust Co., of Baltimore City. He still holds the position of Chief Engineer of the City and Suburban Railway Co.

1. London *Electrician*.

AN ILL-MANNERED TROLLEY CAR CONDUCTOR.

An insolent conductor on a line of trolley cars that runs from Seattle along the shore of Green Lake, got a setback the other day, it is reported, that was as effective as novel. He was a powerful fellow, and had long had a reputation for his impertinence and bullying manners. On this trip he declined to notice the signals of several women, and carried them far beyond where they wanted to go. A stalwart young fellow remonstrated, and the conductor threatened to punch his nose. The young man reached for the bell rope, stopped the car, grabbed the conductor by the waist, and threw him off the platform into the lake. The conductor crawled out sputtering threats, and was promptly punched back again as soon as he stood upright on the bank. Three times he crawled out, and each time was punched back again into the lake. The fourth time he stood up in the water and asked permission to come out, promising good behavior.

N. Y. & N. H. TROLLEY DEALS.

It is reported that negotiations are closed for the acquisition by the New Haven Railroad Company of the property of the Central Railway and Electric Company of New Britain. The company owns an electric light plant at New Britain and about fifteen miles of track, of which about two-thirds parallels either the New Haven or the New England Road, and it is seeking the right to push through a new line paralleling both lines to Hartford, eight miles away. Strength is given to the report by a local situation very similar to that at Meriden, where the New Haven Company has bought out the local trolley company. A newly-elected director of the New England is also a director in the New Britain corporation.

MORE TROLLEY IN NEW ORLEANS.

THE Orleans Street Railway has now put its new trolley system in operation. There is a new power house containing two 200 K. W. General Electric generators driven by Allis-Corliss engine and two 250 H. P. Heine boilers. There are 20 Brill cars on the line, of a very pretty pattern, equipped with a single "G. E. 800" motor. The cars are mounted on Baltimore trucks. A special feature of the cars is that each has 9 lights, 3 in the ventilator and 3 on each side; so that everybody gets some illumination. The officers of the road are P. Cougot, president; J. Pollock, secretary, and H. J. Malochee, superintendent. The work has been done under the supervision of Ford & Bacon, consulting engineers, of New York City.

BEWARE THE BRAKE HANDLE!

Miss Mamie Wolbert was stepping off the front platform of a car on the Nostrand avenue line, Brooklyn, the other evening, when the motorman released the brake and the heavy brass handle swung around and struck her on the head, knocking her down.

The young woman was badly cut about the face and head, and she required the attention of a doctor before she was able to go to her home.

There was a similar accident on one of the Brooklyn Heights Railroad Company's cars a few days before.

TO WHAT SHOULD THE FENDER BE ATTACHED?

A correspondent of the New York *Sun* writes as follows:—Permit me to call attention to the fact that the fatal defect in all the life-saving fenders so far tried in Brooklyn is not in the shape of the part that is intended to lift the victim from the rails. The trouble all arises from the fact that the scoop is attached to the swaying body of the coach. The car simply goes galloping over the rails. The forward end sways up and down until the lip of the scoop rises eighteen inches and even two feet above the pavement when the car is running at a high rate through an unevenly paved street. At ordinary high rates the lip of the scoop rises a foot from the pavement in any part of the city. Let any reader watch the cars and see if this be not so.

So long as the fender is attached to the body of the car—to the platform (as it is now), that must of necessity sway up and down as the car passes uneven places in the track—slaughter of the innocents will continue. There is no conceivable way of keeping the lip of a fender down to the rails so long as the fender is attached to the platform.

But to state the defect is to suggest the remedy. If the fender were secured to the truck frame, having no connection whatever with the swaying body of the coach, almost any sort of a scoop would serve, for the simple reason that the lip of the fender would never be lifted above its normal position by defects in the permanent way or by any other cause. It would always be found right down to the pavement, ready to do its duty.

NEW LINES FOR NEW YORK CITY.

The Metropolitan Traction Co. proposes to construct cross-town lines on Eighty-sixth street and Ninety-seventh street, and it is understood that these will be of the sub-trolley character. They are badly needed by up-town residents.

THE MORRIS & SALOM ELECTROBATS.

We illustrate herewith the two types of electric carriage, the designers of which are Messrs. Pedro G. Salom and Henry G. Morris, of Philadelphia, who have for some time past been at work on the problem of the horseless vehicle. While it was their intention to compete in the recent motocycle race in Chicago, on Thanksgiving Day, they determined in view of the fact that there was a foot of snow on the ground in many places that it would be wiser to await conditions under which a more accurate and exact demonstration could be made; although as a matter of fact the larger electrobat here shown, Fig. 1, travelled about twelve miles through very heavy snow and mud without the slightest mishap of any kind. The owners were, indeed, greatly pleased with the performance, and a gold medal for excellence was awarded them.

The largest of the three, Fig. 1, presents a brilliant appearance, being finished in contrasting red and black, and no machinery being visible anywhere with the exception of the steering lever. It is arranged to seat two persons, but another seat can be attached at the rear, making a total seating capacity of four.

There are two Lundell motors of nominal one and one-half horse power capacity each attached to the front axle, and pinioned on the armature shafts, gearing directly into the driving gears attached to the front wheels. The steering is accomplished by turning the hind wheels parallel with each other from a point about three inches inside of the plane of the wheel, and connected by a rod to a vertical lever of a convenient height to be operated from the front seat of the carriage. This lever is moved backward and forward in steering. Although at first sight it might be supposed that steering from the rear would be more difficult than steering from the front, yet Messrs. Morris & Salom state that the carriage can be moved with the slightest effort on the part of the driver and with the greatest certainty in any direction desired, and can be turned completely around in a circle of twenty feet in diameter.

The wheels are of wood and of the usual construction, except that they are fitted with pneumatic tires and ball bearings. The driving or front wheels are forty inches in diameter and the rear or steering wheels twenty-eight inches in diameter. The batteries, furnished by the Electric Storage Battery Company of Philadelphia, consist of four sets of twelve cells each, having a normal capacity of fifty ampere hours per cell. They are grouped in boxes and so arranged that they can quickly be pushed into place inside the body of the carriage, connection being automatically made with the controller.

The controller is a small instrument standing in a convenient position vertically in front of the seat and is operated by means of a small hand-wheel on top. There are four speeds ahead and

FIG. 1.—MORRIS & SALOM ELECTROBAT WITH LUNDELL MOTORS, WHICH TOOK A GOLD MEDAL IN THE CHICAGO MOTOCYCLE RACE.

one backward, which are obtained by various groupings of the batteries and motors in series and parallel. The carriage has a maximum speed of twenty miles an hour on a good road or street pavement, and the capacity of the battery is sufficient to give twenty-five miles. The weight of the vehicle complete with batteries is 1,650 pounds. The carriage work, which is much admired, was performed by the Chas. S. Caffrey Co., Camden, N. J.

The smaller electrobat, Fig. 2, for the cut of which and of its

FIG. 2.—SMALL MORRIS & SALOM ELECTROBAT.

fellow we are indebted to the *Horseless Age*, might be styled an electric road wagon, and is of an entirely different construction, being built of tubular steel throughout, and the wheels being, like those of a bicycle, pneumatic-tired and ball-bearing throughout. The method of gearing and general operation of the machine is similar to that of the larger electrobat above described. This machine has a maximum speed of about twenty miles an hour and the complete weight with batteries is 1,180 pounds, making it the lightest electrical road machine ever built.

The electric buggy is exactly like the smaller electrobat above described, except in the shape of the frame.

THE CHICAGO ELECTRIC ELEVATED IN A BLIZZARD.

ON November 25th last the most furious snow storm in twenty-four years visited Chicago, and up to noon of the following day, practically cut her inhabitants off from the outer world. The wind blew a gale bringing with it first snow and then rain, and Chicago was turned into a sea of impassible slush. The temperature dropped below freezing and the moisture collected on the roofs and walls and in the streets became a solid mass of ice upon which for hours beat hail and sleet. Telephone, telegraph, electric light and trolley wires, weighted as they were with the accumulation of snow and ice which had settled on them, snapped and fell in all directions. The Police and Fire Departments were paralyzed and surface transit was completely stopped. Not a trolley car, cable car or horse car moved except at exceptionally long intervals and with the greatest difficulty. The residents on the outskirts of Chicago could not reach their homes and the night population of Chicago, became for this occasion far beyond the normal.

Those, however, who lived along the lines of the Elevated roads found some relief. By dint of hard work those operated by steam were able to get trains through, but not without considerable delay, the roads being blocked by fallen poles and wires erected in the streets through which they run.

The sole exception, in all this time of travel tribulation, was the Metropolitan Elevated Railway, of Chicago, which is operated entirely by electricity. No stoppage of moment occurred on this line and the motor-driven trains ran under a shortened headway, satisfactorily carrying, not only the ordinary quota of passengers, but thousands of those who usually depend upon the surface lines to take them home. At the Madison St. Station the crowd was so great that the station and stairways became jammed with the constant influx of people, upon which for several hours the removal of those carried off by the electric trains hardly made any impression.

Throughout the entire duration of the storm, service on the Metropolitan Elevated Railway suffered only two short interruptions. The first lasted nine minutes—the road being rendered impassible on account of a fire in a building adjoining the track. The second of five minutes was occasioned by a slight defect in one of the cars.

This severe storm, made up of almost every kind of climatic unpleasantness imaginable, put the Electric Elevated Railway to the severest test that could have been conceived. And yet in spite of the difficulties which put a stop to surface transit, which interrupted for hours the steam suburban traffic and the steam elevated roads, the electric road was hardly affected. Such a record as this especially emphasizes the superiority of the electrically operated road over roads operated by steam, and serves also as an object lesson which the Elevated roads in New York and Brooklyn might take to heart.

EARNINGS IN DENVER.

The Denver Consolidated Tramway Co. reports gross receipts $710,108 for its last fiscal year, a decrease of $19,134 from 1894, largely due to the use of the bicycle. It has paid a 2 per cent. dividend of $60,000.

GALVESTON, TEX.—Control of the Galveston City Street Railway Company in Galveston, Texas, has passed into the hands of the Rangers of New York. Col. William H. Sinclair, the former President of the company, has disposed of his entire holdings, which amounted to $100,000.

PHILADELPHIA TRANSFERS.—The Union Traction Co., of Philadelphia, has abolished transfers and is now issuing 8-cent tickets, which serve the same purpose, and bring a little more into the treasury. The public objects strongly.

THE RELIANCE FLEXIBLE TROLLEY ARM BRACKET.

ONE of the greatest annoyances in connection with trolley road operation is the jumping off of the trolley wheel. This almost invariably happens at the pole connection and is due to the unyielding nature of the bracket and insulator which support the wire. In order to avoid this constant trouble the Reliance Electric Co., of Philadelphia, have brought out the flexible trolley arm bracket shown in the accompanying engraving. This illustrates

THE RELIANCE FLEXIBLE TROLLEY ARM BRACKET.

the bracket complete with the exception of the insulated bolt in the centre which is attached to the shoe which holds the wire.

The interposition of the spring shown permits of absolute flexibility of motion of pole and wheel, so that the jumping of the wheel when it strikes the pole, and the tearing down of wires, are entirely prevented.

MISCELLANEOUS.

THE DEPARTMENT OF ELECTRICITY AT THE COTTON STATES AND INTERNATIONAL EXPOSITION, ATLANTA, GA.

BY H. M. ATKINSON, CHIEF OF DEPARTMENT.

H. M. Atkinson.

The work of the Electrical Department of the Cotton States and International Exposition has passed from a confused mass of construction into an operating and as it were a living organization, performing various and important duties which will probably have as much or more to do with making the Exposition than any other one feature, and the word feature is used in a collective sense. Restricting ourselves to electrical issues only it will be seen that these are by no means few, including lighting the buildings and grounds, the general beautifying of the Exposition as a whole, the patrol and alarm systems, communication at all times between the different Departments, supplying motive power, transportation by land and water, special features of attraction for the evening, and finally the manifestation as shown in the service plant and the exhibits in the Electricity Building of the many advanced uses of electricity and the progress that has been made since the great exhibit at Chicago only three years ago in the field of electrical invention. The reader will see what a comprehensive field the above is and what it means to the success of the Exposition.

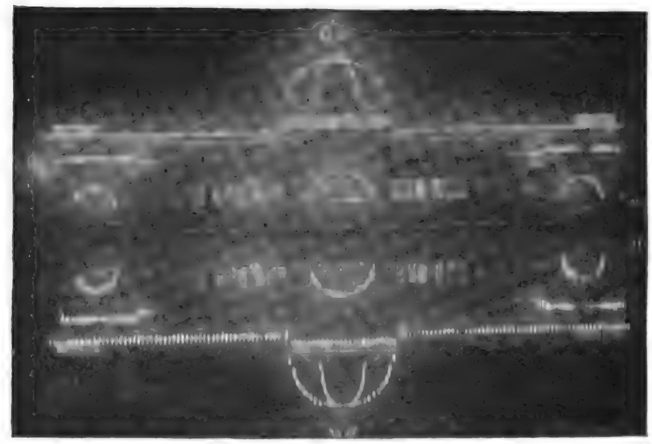
The development of the work of this Department has taken continued thought and hard work from the day of the inception of the Exposition. The work is now an accomplished fact and for some time has been in evidence to the general public. There is no such enormous and prodigal display of lighting as was shown at Chicago but it can be safely said that those who are interested in electrical progress and in the proper display of the abilities of

GENERAL VIEW SHOWING FOUNTAIN TO THE RIGHT.

electricity to play its part in such enterprises as this Exposition are more than gratified by the work that has been done and the intelligent purpose with which it has been carried out.

Of course the display as it is seen and the varied work of the Department are the result of a long process of incubation and of many suggestions and ideas that came from as many quarters. No Department could have proceeded with its work more harmoniously, and full swing has been given to those experts who were chosen to design and execute the work in carrying out their plans. It can be safely said that the work of the Department represents more freedom in the exercise of their judgment and in the execution of their plans than in any work of the same character that has been projected. After general lines were laid down, always with an eye to the treasury, the experts have been allowed to work out their own salvation without interference from uninitiated laymen, as has been too often the case in expositions, and by reason of which the harmony of the work in many lines has been distorted and marred. The Department was organized early and proceeded with its work under an intelligent and definite organization, and latterly with a swiftness and accuracy of purpose which were undoubtedly proofs of genius in those to whom the work has been intrusted. Up to four or five months ago the planning and thinking had gone on unceasingly for a period of over a year, but at the time mentioned the emergency of swift decision arose and the thoughts and plans were executed with a rapidity and pertinacity that is worthy of the highest admiration.

The work of the Department may be divided into three main



ELECTRICITY BUILDING REFLECTED IN CLARA MEER.

fields; which in turn may be subdivided into innumerable small features each having its own duty and scope. The three main divisions are: first, the service plant in its entirety, which puts the throb of life into every section of the Exposition grounds; second, the Electricity Building, the aim of which is to show by exhibits the progress of the science of electrical invention and manufacture up to the present time; third, the electrical fountain and those special features of embellishment and ornamentation which can justly and truly be said to form an important division. It will be impossible in this brief article to enumerate in detail the parts that go to make up these three main divisions, even though there is not such immensity as was shown at Chicago, which may certainly be regarded as a relief to the visiting public; but each one deserves a few special words.

First, The Service Plant. The words "service plant" mean the agency by which the lighting of all sections of the Exposition grounds and the motive power are furnished, and these few words show the far reaching importance of its duties. The service plant of the Cotton States and International Exposition Company is an electric lighting and power plant that is fully up to the year 1895 in all details. The latest methods of operating electric machinery are presented to the visitor, and the newest types of electrical apparatus are in operation before his eyes. This service plant shows the progress made since the World's Fair in electrical science. The transmission of power, which is now assuming such importance in industrial progress, is shown. The latest types of lighting and power apparatus are presented, but no particular make or style of apparatus has undue prominence. There are belted machines and direct coupled machines and also other types, and their work is in direct evidence in the illumination of the grounds at night. All the various systems of lighting are in practical use; alternating and direct currents are used both for lighting and power purposes, and on one set of wires generated from one common dynamo may be seen arc lamps, incandescent lamps, motors and heating appliances. The storage battery is seen in one of its most practical and attractive applications, that is, in the electric launches; in short, the whole electrical domain is covered by all that is latest and best. Telephony is represented by a most complete and practical exhibit with a central exchange in operation and in daily use throughout the grounds. The exhibit in this department shows a better and more complete display of telephonic apparatus than has ever been collected before in one exhibit.

Second.—While many disadvantages and obstacles have been met with in filling the Electrical Building with a representative exhibit, it can be said that the work has been fully accomplished and that every nook and corner of the building are

THE CHIMES TOWER.

filled with the latest evidences of the activity of electrical ingenuity and of the untiring enterprise of the manufacturer in this line. The service plant itself is a complete and varied exhibit of electrical apparatus in motion, and as all the leading manufacturers of electrical apparatus have contributed largely to the apparatus in the service plant it has been extremely difficult to get them in addition to make expensive and important exhibits in the Electricity Building, but in spite of all obstacles, the work has been done and is a self-evident illustration of the success that has attended the efforts of this Department. The very lack of immensity and vast size have simplified the work before the intelligent visitor and enable him to see and learn more than he could had mere bulkiness of exhibits been sought. The exhibits in the Electrical Building cover the field and are sufficient to satisfy the mind of the expert or the layman.

Third.—The twin electric luminous fountain Atlantis is one of the sensations, if not the sensation, of the Cotton States and International Exposition. The special features that have been designed for the electrical embellishment of the grounds and lakes furnish a suitable setting for this creation. These features were early placed in the hands of the most competent electrical expert in this line in the United States. He was given full scope for the indulgence of his experience and fancy, and the department calmly awaited the unanimous verdict of the multitudes that assembled on the banks of Clara Meer and in other parts of the beautiful grounds, upon its work in this particular. The electrical fountain in execution and design is fully up to the standard set by all other branches of electricity at the exhibition. This fountain is undoubtedly by far the most complete electrical fountain ever built and in variety and beauty of effects far surpasses anything hitherto constructed. The water effects are endless in variety, including the mist bank, lily jet, geysers, wheat sheaves, ring curtains and parabolas, many of which forms have been tried for the first time in Atlanta. The power of the lamps by which the fountain is illuminated, the capacity of the pumping plant for furnishing the water for the fountain and all other particulars are upon an immense scale.

The aims sought by this Department have been not to gain any undue prominence in the making of this Exposition but it has been solely actuated by a desire to bring out and assist in beautifying the work so well done by the landscape engineer and the architect. The lighting embellishment of the buildings is original. Each building reveals its own individuality so that it can be easily picked out and distinguished. Each building is a picture and the stereotyped sameness which has been so often seen has been avoided. Each light from the immense search lights running up to many thousands of candle power, down to the smallest incandescent light of two-candle power has been placed with a definite purpose, and no light has been so small as to escape the attention of the artist who designed the lighting scheme. The whole design of the lighting has been carefully thought out in every detail and each lamp has been placed in its position just as the artist applies the touch of color here and there to his canvas. These few words will show the amount of thought that has been spent upon this subject. It can be said with perfect truth that not one single particle of light has been applied to the grounds except for a definite purpose and after study and thought. Many special appliances have had to be devised and much ingenuity has had to be used in bringing about the desired results and the designers of the lighting scheme have worked with a full appreciation of the labors and success attained and brought about by the heads of the Department with which they have worked side by side. This intelligence of effort and harmony of purpose have aided in producing an exhibition which will permanently hold an honorable place in the long list of special and national fairs. In addition it may be said that the work of this Department has signalized and manifested in many ways the general gains and advances in the governing conditions of everyday life, which is the true aim of all such exhibitions.

To briefly summarize: first, all the practical uses of electrical invention are placed before the eyes of the visitor; second, the uses that can be made of electricity in embellishing and beautifying are manifest, and all its qualities that make for refinement and higher æstheticism are displayed; third, all the various improvements in electrical invention that aid in the development of the arts and sciences and that round out the comforts of life and promote social welfare are exhibited. And this has been attained by collecting upon representative lines the latest and best in this field of the industrial development of the day.

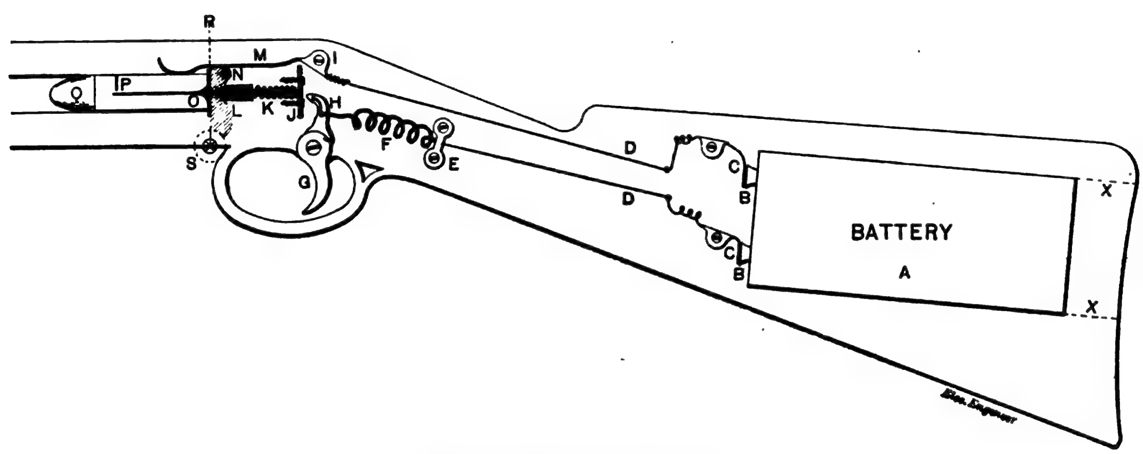
It will be seen from the above that electricity at the Atlanta Exposition does its part in demonstrating the progress of the age and the latest improvements in the comforts and necessities of life. And this is what the success of an exposition consists in. It is nothing but an object lesson of what has been done and its true function is as an educator, and to furnish inspiration for the future.

THE BLAKE ELECTRIC RIFLE.

The practice of firing big guns by electricity is already well established, but hitherto no practical attempt has been made to explode the shells of small arms electrically. An electric rifle has recently been designed by J. F. Blake, of New Haven, Conn., in which it is sought to carry out this principle. The source of the current is a battery A, which is fitted into the stock either from the side or from the ends. The holes B B are connected to springs C C, from which the wires D D run respectively to a spring M, bolted at I to the lock plate, and to the insulated hammer H fixed on the upper part of the trigger G. Q is the shell containing an insulated pin the head of which O, projects beyond the base of the shell. If necessary, two pins can be placed parallel with each other and insulated until their points nearly meet. Between the base of the cartridge and the hammer is a pin K encircled by a spring and riveted into a cross plate J at one end, the other end being fitted into an insulated thimble L, the point of which nearly touches the shell pin head O. When the cartridge has been inserted and the gun closed, the spring M rests on the metal base of the cartridge.

As the trigger is pulled, the hammer strikes the plate J forcing the point of the thimble L into contact with the projecting end O of the cartridge pin. An arc is established at P O, which explodes the contents of the cartridge.

The point of the firing pin P can be placed anywhere within the explosive powder of the cartridge, but by extending it near the bullet, as shown in the illustration, a more effective explosion of the powder is secured.



THE BLAKE ELECTRIC RIFLE.

NEW YORK CITY LIGHTING.

THE New York Gas Commissioners met in the Mayor's office last week and opened bids for lighting the city next year. The total estimated cost is a little more than a million dollars. The various gas and electric light companies made the same bids as last year, and the slight increase in the total is due to the fact that there will be 172 more electric lamps below the Harlem River. The bids are as follows:

Electric lighting—Brush Company, 720 lamps, at 40 cents each per night, and 92 at 45 cents each; Madison Square Company, 312 lamps at 40 cents and 10 at 50 cents; Mount Morris Company, 361 lamps at 40 cents; Harlem Company, 212 lamps at 40 cents and 19 at 50 cents; Manhattan Company, 241 lamps at 40 cents; Edison Company, 125 lamps at 50 cents; North River Company, 330 lamps at 45 cents.

ELECTRICAL TANNING.

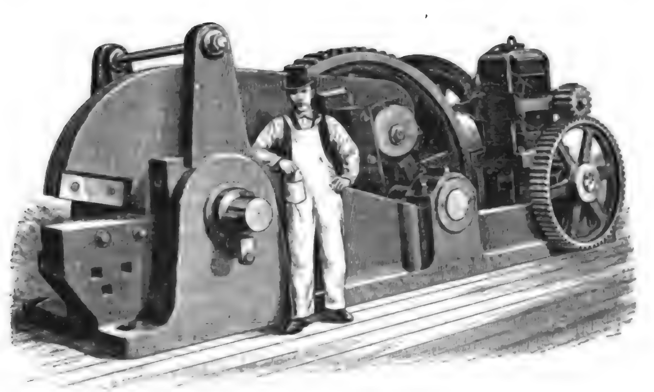
In the *Zeitschrift fuer Elektrochemie*, Herr Folsing, states that he has worked out an electrical method of tanning, which he considers is suitable for both thin skins and heavy hides, and only requires three to six days. The tanning pit contains 15,000 litres. Electrodes of nickeled copper are fixed to the walls of the pit, in which the hides are hung so that the current has to pass right through them. A current of 12 amperes with an E. M. F. of 12 volts is used. The color of the leather is not quite satisfactory when commercial unpurified extract is used. The author lays stress on this, and he himself uses an oak extract (with a little hemlock extract added) which is cleared and decolorized by a special electrolytic process. When this is used he finds that the color is exceedingly good and bright. Light cow-hides were found to require 72 hours, heavy cow-hides 5 days, and heavy ox-hides 6 days. The latter would require about a year by the old process.

AN ELECTRICALLY DRIVEN SHEAR.

THE accompanying engraving illustrates probably the largest shear to which electricity has been applied as a motive power, and this will, without doubt, lead to a much more extensive introduction of that power to drive independent machines in iron and steel plants. This ponderous machine was built by the Frank-Kneeland Machine Company, Pittsburg, Pa., for the Granite City Steel Company, Granite City, Ill. The shear is located in the scrap yard, about 600 feet from the boiler. The suggestion of driving by electricity was made by G. L. Luetscher, superintendent of the works, to attain economy and convenience of transmitting the power, freedom from annoyance of draining and freezing in winter and the ability to operate the machine under all conditions with cheap labor.

The motor is a slow speed, steel frame, constant speed machine. The armature makes but 500 revolutions per minute and is controlled by an extra heavy rheostat that will admit of starting the motor very slowly. This is a very important feature, because the inertia of the fly wheel, gear wheel and lever of the shear require great power to start them.

The shear itself is the heaviest of its kind, weighing, with the motor, over 90,000 pounds, and is calculated to exert a pressure of



THE FRANK-KNEELAND ELECTRICALLY DRIVEN SHEAR.

900 tons at the centre of the knives. It has capacity to cut 4½ inch square soft steel billets, and as large a section of rounds as is now used in railroad axles. The knives are 18 inches long and may be extended to 24; are 7 inches deep and 2½ inches thick. The bed is massive and intended to absorb the great shocks due to heavy cutting. It alone weighs 44,000 pounds. The cutting edge of the knives is exactly central between the housings, thus throwing an equal strain on both housings, utilizing the material in the best manner. The housings holding the main pin are 30 inches wide and 14 inches deep each. They have a bearing and wedge to take up lost motion; they are extended upward to carry a tension bolt 2½ inches diameter, which assists the main pin in its work of holding the spread of the housings. The main pin is a low phosphorous steel forging, 8 inches in diameter, having a head forged on one end and a loose steel key and collar on the other end. It is held from turning by a feather the full length of its bearing in the lever. The lever is 14 inches through the knife seat, to insure great strength sideways, to resist the cross strain when the knives are dull. This is too frequently the case in practice, and probably is the most fruitful source of breaking shearing machinery when cutting light material. It has great depth to transmit the enormous strain of the regular work. The main feature is the recess, 7 x 9 inches, in the tail of the lever, which forms a socket in which the pitman operating it bears. The recess is babbitted and has lubricating holes at the top.

The feature of operating the lever by a pitman is novel and reduces the power to operate the shear materially under that of the cam, while in this particular construction the slow closing and rapid opening of the knives is maintained by placing the centre of the crank shaft forward of the centre of the recess in the lever. The fly wheel shaft is 6 inches diameter, forged steel, and has a substantial outboard bearing and sole plate.—*The Iron Age.*

ON THE POISONOUS ACTION OF ACETYLENE.[1]

BY M. N. GREHANT.

Thanks to the extreme kindness of M. Moissan, who has given me a sufficient amount of calcium carbide to prepare several hundred litres of acetylene, I have been able to make a series of comparative experiments, which I have the honor of presenting to the Academy.

I caused to be introduced into a mercury test glass, well dried, 400 grams of carbide of calcium. A rubber cork pierced with two holes received a glass funnel with a cock in it and the other end a conducting tube, which carried the gas obtained by the flowing of water, through the glass retort, which allowed the regulation of the outflow; when all the air had been forced out, and when the gas obtained burned without explosion, the acetylene was received in a gasometer (model of Dr. Saint-Martin).

I successively titrated mixtures of acetylene, of air and of oxygen, adding always 20.8 of oxygen as in the atmospheric air.

Mixture of 20 *to* 100.—I caused a dog to breathe a mixture composed of 20 to 100 of acetylene; the animal remained quiet; the respiratory movements became larger in extent. At the end of 35 minutes, 44 cc. of arterial blood were injected into the empty receiver of the mercury pump, and I extracted the gas which had been collected over the mercury, in a little bell with a glass cock; after the absorption of the carbonic acid by potash, the gaseous residue was introduced into the fire damp indicator whose receptacle had been filled with three quarts of air, and the gaseous mixture was contained in the receptacle and in the entire length of the graduated tube. At the first passage of the current, we saw a very clear blue flame and a detonation was produced with a sharp sound; the reduction was equal to 82.4 divisions and indicated a considerable volume of acetylene, which had been absorbed by the blood; 1 cc. of acetylene giving a reduction three times as large as that of carbonic oxide gives; that is to say, $3 \times 6.6 = 19.8$ degrees in my fire damp indicator; 100 cc. of blood contained 10 cc. of acetylene.

Mixture of 40 *to* 100.—The oxygen of Passy contains 90 to 100 of the pure oxygen; in order to obtain a mixture of acetylene of 40 to 100, the calculation indicated that it was necessary to add 55 litres of this gas, 66 litres of air and 16.5 litres of oxygen, in order to prepare a mixture containing 79 of acetylene, and 20.8 of oxygen. A dog who breathed this mixture, after having presented a long period of agitation, circulated in its lungs 112 litres of the mixture. Suddenly, 51 minutes after the commencement of the experiment, the animal extended its paws and died; the heart had stopped; we drew off the blood into the lower vena cava; it revealed in the fire damp indicator, the presence of 20 cc. of acetylene in 100 cc. of blood.

Mixture of 79 *to* 100.—I made a mixture of acetylene and oxygen in which combustible gas replaced the nitrogen of the air. At the end, a dog caused to breath this mixture, presented a continual agitation and very ample respiratory movements. Eleven minutes afterwards, we observed general convulsions; 27 minutes after the commencement, he extended his paws, and there were some painful respiratory movements, which preceded death.

This mixture of 79 to 100 was conducted into a bell formed glass jar in which there was a guinea pig. In six minutes the animal fell upon its flank; had convulsions, fluttering movements of the limbs and of the head; at the end of 39 minutes, we drew out the animal which rested flat on its flank. Some minutes later the guinea pig raised itself and revived, but it died during the night.

I concluded from my experiments that the acetylene is poisonous when one employs a strong dose, if administered in large doses between 40 to 100 and 79 to 100; the employment of the fire damp indicator easily allowed the discovery of this gas in the blood.

I endeavored also to compare the poisonous quality of acetylene with that of illuminating gas. Starting from the fact often proved by analysis that coal gas (illuminating gas) contains 7 to 100 of carbonic oxide, I made a mixture of 150 litres of air, 5.8 of oxygen, and 20 litres of coal gas, which should contain 1 to 100 of carbonic oxide and 20.8 of oxygen. A dog forced to breathe this mixture presented at the end of three minutes a lively agitation, and at the end of six minutes very violent movements of agitation. We took ten minutes after the commencement of the experiment blood from the carotid artery, and from 100 cc. we could withdraw 27 cc. of carbonic oxide. The dog when released remained lying on the floor; was very sick; and if the experiment had lasted some minutes more it would have died. Illuminating gas is, therefore, much more poisonous than acetylene.

1. *Comptes Rendus*, Oct. 21, 1895. Presented by M. Moissan.

LEGAL NOTES.

UNDERRUNNING TROLLEY CONTACT PATENT SUSTAINED.—THOMSON-HOUSTON ELECTRIC CO. vs. THE WINCHESTER AVE. RAILROAD CO. et. al.

On Dec. 9, Judge Townsend, of the U. S. Circuit Court, District of Connecticut sitting at Hartford, Conn., rendered a decision upholding the validity of the fundamental Van Depoele underrunning trolley contact patent but declaring void the Van Depoele patent covering a rotating support for the post upon which the contact arm swings.

We quote below the salient points of the decision:

"Complainant, by this bill, asks for a perpetual injunction and an accounting, by reason of the infringement of Patents No. 495,443 and No. 495,383, granted April 11, 1895, to the administrators of Charles J. Van Depoele, assignor to complainant.

"Both of said patents cover useful improvements in travelling contacts for electric railroads which are in general use in the trolley railway systems in this country, and both have been infringed by defendant. They will be designated hereafter as the first and second patents respectively; No. 445,443, the main patent and the earlier in date of application, being called the first patent. The defense is conducted by the Westinghouse Electric and Manufacturing Company, one of the parties defendant. The defenses to said first patent are, that the alleged invention was made by an employé of the Van Depoele Company; lack of patentable novelty in view of the prior state of the art, and that the same invention had been previously disclosed by and patented to Van Depoele

"The alleged invention relates to improvements in the devices whereby contact is maintained between the trolley car and the overhead wire conductor. It embraces the long swinging, pivoted hinged, and upwardly spring pressed arm, and equipped with an under running contact device. The combination of devices described in Patent No. 495,443 is of great utility in the art of electric railroading and has superseded every other known apparatus. The experts for defendant admit that they do not know that anyone other than Van Depoele, prior to September, 1885, when he put said apparatus into practical operation, had proposed to equip the car of an electrically propelled road with a contact device mounted on the end of a long pole upwardly pressed by means of a spring, and to hinge the pole to the car and make it turn on a pivot, nor that anyone, prior to March 12, 1887, the date of the application for the first patent, had described, in an electric railway, the combinations specified in the infringed claims.

"The defendant, in support of its denial of patentable novelty, in view of the prior state of the art, shows generally that electric railways, suspended conductors, and contact devices, were old, and that the utility of such devices for conducting the current from such conductors to the instrument on the car, was well known and variously applied.

"These systems, so far as the present consideration is concerned, were chiefly used either for electrically lighting a car, or for signalling to or from it. But defendant claims that, as in each case the object to be accomolished was to get a current from a conductor to a motor in the car, the difference in the ultimate result is immaterial.

"Counsel for complainant, on the other hand, claims, relying upon the long settled rule of law as recently fully discussed and stated in Potts *vs.* Greager, 155 U. S. 597, that said devices, as a matter of law, do not anticipate the patented device, because they relate to a remotely allied art, and did not suggest in their construction the particular problems which were presented by the conditions of trolley systems and solved only by the inventions of the patent in suit. He further relies upon the fact that material alterations were required to adapt these devices to said new use, and that the effect of said transfer has been to supersede other methods of accomplishing said results."

The Court then discusses the patents of Bolton (British); Fitzgerald, No. 91,732; Brunius, 189,999; Wesson, 16,665; Daft, 412,605; Sherman, 302,596; and others, and says:

"As is forcibly urged by the counsel for complainant, the fact that numerous skilled inventors, when first confronted by the problem of overhead contact, did not adopt, adapt, and develop the electric railway signal art, already considered, but started out on the new and independent lines of the overrunning trolleys, is most significant upon the question of invention in the patent in suit. That they, working with a single object in view, rejected said existing allied or analogous art as impracticable, and invented improvements upon other lines, which have since been discarded for the improvements afterwards made upon the existing art, is presumptive evidence that invention was required in the selection from and adaptation of the existing art.

"It remains to inquire, assuming that the Van Depoele device possesses patentable novelty, whether he was the original inventor thereof. The evidence bearing on this question shows that for some time prior to 1885, he had had in mind an electric railway similar in principle to that constructed in Toronto. In his application for the patent he swore that he was the original and true inventor, and it does appear that during his life any other person claimed the credit of said invention. But after his death and upon the taking of the evidence in this case, one Verstraete, a witness introduced by complainant and a former employé of the complainant, testified that the trolley originally designed by Van Depoele for the Toronto Exhibition was impracticable; that he went down to a shop in the city and himself made a crude form of the patented device and attached it to the car and that Van Depoele said he was glad he had fixed it in that way. While there is some evidence tending to show that Van Depoele had charge of the construction of said trolley arm and that Verstraete worked under his directions, I am not inclined to rest my decision thereon. It seems to me that, in these circumstances, such evidence from a former employé, after nine years of silence, should not be believed as against the oath of the patentee, especially when other evidence on behalf of the patentee is not accessible. Furthermore, Van Depoele in an affidavit made in the course of the proceedings in the Patent Office on the application for the patent in suit and introduced in evidence by the defendent herein, swore that 'he completed the invention, shown, described, and claimed, prior to the year 1885,' and 'that during the year 1885 he reduced the invention to actual practice by constructing and operating a full size electric railway which was successfully used for the conveyance of passengers as represented by a photograph taken during that year, a copy of which is hereto attached.' Said photograph represented the Toronto road and a car equipped with the device of the patent in suit.

"The burden of proof is on the defendant to overcome the oath of the inventor, and this it has failed to do. Allen *vs.* Dewey, 1 Story, 336; Woodward *vs.* Sherman, 3 Story, 171; Spill *vs.* Celluloid Co., 2 Fed. 707, 711; Worswick *vs.* Buffalo, 20 Fed. 126, 128.

"No one can read this record without being impressed by the fact that Van Depoele was more than a skilled mechanic in the art of electrical railway propulsion. The Patent Office has raised a presumption in his favor as an inventor by the grant of numerous patents to him. Some thirty have been introduced by defendant, several of which cover highly meritorious inventions which have, largely contributed to the successful practical operation of the trolley roads throughout this country. In fact the construction covered by his earlier patent for an overhead under-running trolley shows that he appreciated the problems involved in varying lines and curves, and to a limited extent by said device ingeniously provided for their solution.

"The inventors in the art of electrical propulsion, signals or telegraphs, had failed to provide for an operative contact device at the distance from the car required for the operation of the underrunning trolley road except by unwieldy and impracticable structures on the roof of the car. They had failed to adequately provide for considerable variations from practically straight lines of travel. In their later attempts to do so they had constructed or adopted contrivances which departed from the earlier devices now claimed to show lack of patentable novelty, and thereby furnished strong proof that the changes made by Van Depoele were not obvious ones. Defendant's expert is forced to admit that the advantages of an underrunning trolley were not obvious and that the earlier constructors must have been in doubt as to the efficiency of such a system, and that the prior underrunning overhead devices would have led a person away rather than towards an upwardly pressed hinged conductor. In these circumstances the new use of old principles does not fall within the rule of a double use.

"I have been unable, therefore, to adopt the view of counsel for defendant, that the art of conducting electricity from a conductor to a translating device on a moving vehicle, was sufficient to enable the skilled mechanic to construct the device of said first patent.

"In respect of the underlying fundamental object and result of the paper patents for signaling devices, and the Van Depoele device, the transfer was 'to a branch of industry but remotely allied to the other and the effect of such transfer has been to supersede other methods of doing the same work.' Potts *vs.* Creager, *supra*. Clearly this construction required 'as acute a perception of the relation between cause and effect,' and as forcibly illustrates the 'peculiar intuitive genius which is a characteristic of great inventors, to grasp the idea that a device used in one art may be made available in another as would be necessary to create the device *de novo*.'

"Counsel for defendant further claims that the invention embraced in the patent in suit was previously disclosed in prior patents to Van Depoele and patented by him, and that even 'if the broadest form of the invention was not patented therein nevertheless that the form claimed in the patent in suit was so inseparably involved in the patenting of the invention in the forms described and claimed in prior patents, that the right to the patent was exhausted upon the issue of the prior patents and the broad form was waived and became abandoned to the public.' In support of this contention, counsel for defendant chiefly relies upon Van Depoele Patent No. 424,695, dated April 1st, 1890, for 'Suspended switches and travelling contact for electric railways.' The main invention therein claimed relates to an improvement in the arrangement of contact switches. In this connection the patentee also claims an improved contact device for use in connection with such switches. The patent states that it is a division of the application which forms the basis of the application of the patent in suit, and that the patentee herein only claims certain details of such invention, especially valuable in connection with switching devices. The drawings and much of the description in the two patents are practically identical. The description in No. 424,695, however, states, as one of the subjects of this invention, the following:

"And while the arm F is movable laterally with respect to the vehicle, the spring and weight will constantly tend to restore the arm to its normal central position, and to assist in causing the contact arm to partake of the lateral movement of the vehicle."

"The original application was delayed by interference proceedings in the Patent Office. Whatever may be the rule as to cases where the application for the generic patent was filed subsequent to the application for the specific patent, I do not think the patentee should be deprived of his broad patent where the application for such patent was made first and was delayed in the Patent Office through no fault of the inventor. Such a ruling would be a reproach to the law.

"This precise question came up before Commissioner Mitchell and was decided by him November 27th, 1889, in *Ex parte* Edison, 49 O. G., 1691, 1693.

"The question whether the issuing of a subsidiary patent before a primary patent without the fault of the inventor, when the primary patent was first applied for, was not before the court and was not passed upon.

In Suffolk Co. *vs.* Hayden, 3 Wall. 315, cited in Miller *vs.* Eagle Mfg. Co., *supra*, a case closely resembling the one at bar was presented. The Supreme Court there held that, where an inventor first applied for a patent for a more generic invention, and in a subsequent application described this invention, but only therein claimed it in combination with other improvements, there was no presumption of abandonment, and the patent for the invention covered by the earlier application would be valid, even though later in date of issue than the patent for the subordinate combination.

"Finally, the decision of the Circuit Court of Appeals for the Second Circuit, in Electrical Accumulator Co. *vs.* Brush Electric Co., 52 Fed. 130, affirming the decision of Judge Coxe in Brush Electric Co. *vs.* Electrical Accumulator Co., 47 Fed. 48, is directly in point and seems to be controlling upon the questions presented herein.

"Patent No. 495,383, herein known as the second patent, is for an overhead contact device and switch. Complainant claims that defendant has infringed claims 11, 12, and 13 thereof. Each claim covers practically the same construction, namely, a rotating support for the post upon which the contact arm swings. The defenses are practically the same as those considered with reference to the first patent. The patent comprises 'an improved apparatus whereby the upward-pressing contact is maintained against the conductor,' and 'means for reversing the position of the contact arm upon the car.'

"In the first patent in suit No. 493,443, the spring which maintained the upward pressure of the underrunning wheel was so fastened to the car, or otherwise arranged, as to interfere with the lateral movements of the swinging arm. By the substitution of this rotatable support and the attachment of said spring thereto, such movements are unrestrained, because the spring rotates with the support. Furthermore, it is unnecessary to turn the car about in order to run it in an opposite direction, because the apparatus being reversible, the arm may be so adjusted as to trail rearwardly from the supporting post.

"Patents No. 197,195 granted November 13, 1877, to Wolf for an improved tilting chair, and No. 221,651 granted November 11, 1879, to E. Wright for an animal tether, show that rotary spring devices attached to reversible supports were old. As Mr. Brevoort, one of defendant's experts says: 'Now it was clearly old to use trailing trolley arms. Parrish and Munn showed how to make any one of these reversible, and the chair patent and the animal tether show mechanisms which any mechanic could utilize had he wished to and had he desired to obtain that class of reversibility to which Parrish and Munn referred, or that class of reversibility which is found in complainant's structure, where in one case, to wit in Fig. 5, the springs are always attached to the support and moved therewith, this being the class of mechanisms of the Parrish and Munn earlier patent, the chair patent and the cow tether patent.' He adds that the office chair construction was so universally known and understood, and reversibility of a structure such as a trolley pole was so fully described and shown in the Parrish and Munn patent that 'after this it became merely a matter of selection on the part of a mechanic as to what mechanism he would employ to obtain the old and well known result.' I am constrained with some hesitation to adopt this view.

"The reason for the universal adoption of the device of this second patent follows as a corollary from the foregoing conclusions. Its adoption results not from its patentable novelty, but from its practical utility in connection with the main invention. The doctrine that utility, in the absence of patentable novelty, is immaterial, is especially applicable where the sole foundation for the claim of utility lies in the mere mechanical adaptability of a well known device to a novel invention protected by a valid patent.

"Let a decree be entered for an injunction and an accounting as to the claims in Patent No. 493,443, and dismissing the bill as to Patent No. 495,383. Let costs be taxed in favor of each party, as each succeeds as to one patent, but let judgment be entered only for the excess of the costs of one party over the other."

Trade Notes and Novelties

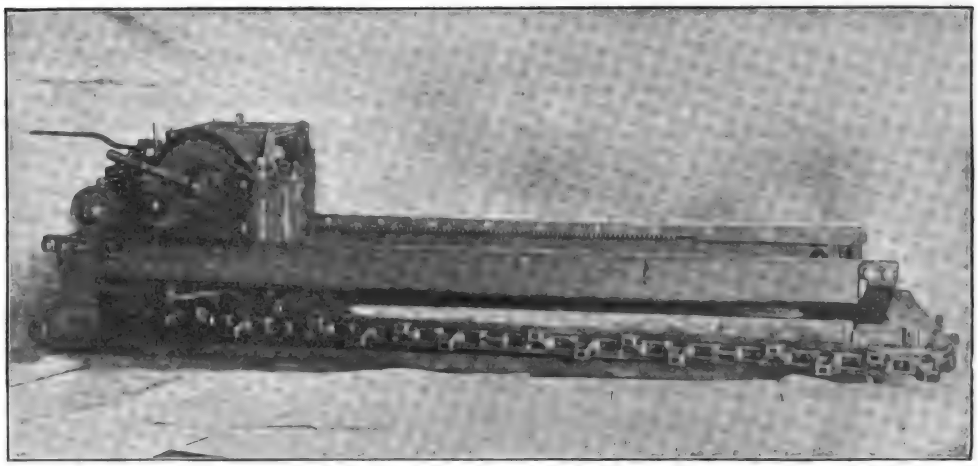
AND MECHANICAL DEPARTMENT.

THE CHAIN AND PICK MINING MACHINES OF THE MORGAN-GARDNER ELECTRIC CO.

The accompanying engravings illustrate two types of machines constructed by the Morgan-Gardner Electric Co., of Chicago, and specially adapted to coal mining.

The chain machine, Fig. 1, weighs 2,400 lbs., and will run in the full depth in 4½ minutes and back in 45 seconds. This speed can be increased to 3½ minutes, and 30 seconds backing out, according to quality of coal.

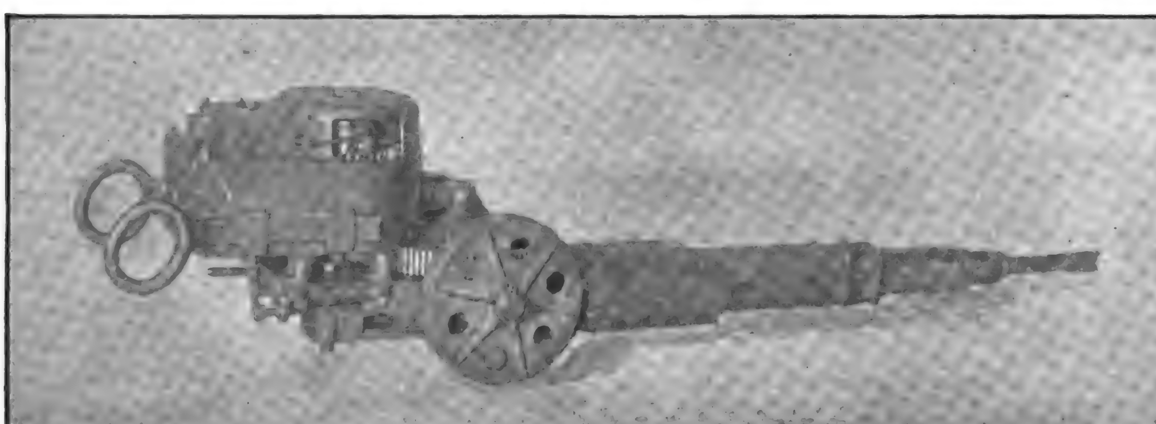
The total length of the six-foot cutting machine over all, is ten feet. Height is 29 inches over all. Width across the machine a cutter head is 42 inches over the chain, and 45 inches over the bits, thus giving full 42 inch cut and allowing a lap into previous cuts. The width across the frame is 24 inches; this enables the machine to be loaded on a truck that will run on a 28 inch track without making a special truck; and on a smaller gauge by making a special truck.



CHAIN MINING MACHINE OF THE MORGAN-GARDNER ELECTRIC CO.

The motor is of the multipolar type, with internal fields; this type of motor is very compact and also easy to get at.

The gears are all made from steel with teeth cut out of the solid. The fact that the armature runs on end does away with the bevel gears and greatly simplifies the gearing, as all gears are plain spur gears and only one worm wheel is employed.



PICK MINING MACHINE OF THE MORGAN-GARDNER ELECTRIC CO.

The machine is so constructed that both machine runner and helper can work at putting in bits at the same time. There are 48 bits in a chain of six foot under cut. The materials used in construction are cast and wrought steel throughout, with the exception of a very small amount of iron, which is used where strength is not required. The break washer, or safety washer, adds great security against accidental breaking.

The speed of travel of the chain is 273 feet per minute; revolutions of armature per minute, 750, with 220 volts at the machine.

The pick machine, illustrated in Fig. 2, is used to great advantage in entry driving, cutting necks and turning rooms, or any narrow place where it is difficult to use the chain machine. The machine can cut 60 feet, 4½ feet under per shift of nine hours with ease, operated by one skilled runner and one laborer. The machine has a reciprocating piston, actuated by a spring and cam, the spring striking the blow and the cam drawing the piston back. The cam is in turn driven by an improved motor with specially constructed armature. The latter is of the toothed Gramme ring type, with coils wound below the surface. The important feature is the manner of connection of the commutator to the coils, there being no wire connection at this point, which makes the armature as nearly indestructible as it is possible to make it. The stroke of piston is 18 inches and it runs from 175 to 225 strokes per minute. The length of the machine is 7 feet; width over wheels, 21 inches; weight, 850 pounds.

NEW YORK NOTES.

THE NIAGARA ELECTRIC CHEMICAL CO. has been incorporated in this state to manufacture chemicals and chemical products. The capital stock is $100,000. The directors are H. Y. Castner, of London, Eng.; Jacob Hasslacher, of New York; Franz Roessler, of Perth Amboy, and W. A. Haman, of Mount Vernon.

MR. C. R. HUNTLEY, of the Buffalo General Electric Co. was a welcome visitor to New York last week. He is taking, as one of the ex-presidents of the National Electric Light Association, great interest in the coming E ectrical Exhibition, which he is anxious to see a great success, as he believes it may stimulate electrical work in a very marked manner. With good management, on dignified lines, Mr. Huntley thinks the Exposition will do incalculable good to the industry.

NEW YORK FIRE DEPARTMENT.—An investigation is going on as to purchases made by Supt. J. Elliott Smith, and as to the method of charging for signal boxes.

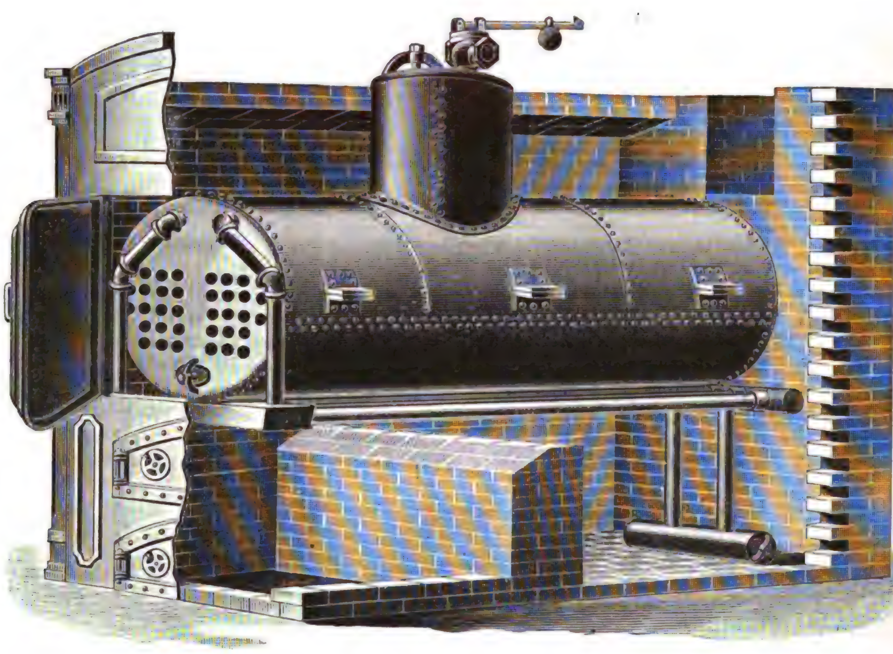
DIXON'S SILICA GRAPHITE PAINT, manufactured by the Joseph Dixon Crucible Co., of Jersey City, N. J., will be used in painting all the tin work and skylights of the Post Office Department Building at Washington. A quantity will also be used on the Capitol, and the District Government Building.

THE HASCALL-RICHARDS STEAM GENERATOR.

EXPERIMENTS have shown that those parts of a boiler on which the flame acts directly are far more efficient than those in which heat is conveyed to the water by hot gases after they pass beyond those points. With this fact in mind, Mr. Jas. J. Bush some time since devised a plan for increasing the economy of a boiler by the addition of what may be called an auxiliary generator, which in its latest development takes the form of a series of straight pipes placed horizontally under the boiler and extending at full length, as shown in the accompanying illustration. The front end of these tubes is connected by a waterleg and pipes to the steam space in the upper part of the boiler. The action will be readily understood.

The moment the fire is started, the heat strikes the generator pipes, and the generation begins of steam, which forces its way through the pipes into the front of the boiler above the water-line. As the steam passes out of the pipes, the water rushes in from the rear end of the boiler, and the elevation at the point of discharge above the water-line at the front end of the boiler, being a principle of the generator's construction, it causes a constant, surging circulation of water through the boiler and pipes. At the rear end of the boiler the generator has all the water in the boiler together with the pressure of steam to force the water through the generator pipes and into the boiler, while the front has only the pressure of steam. On account of this rapid circulation the sediment is removed and incrustation is claimed to be impossible, so that the life of the boiler is necessarily prolonged.

It will also be noticed that these horizontal generator pipes are



HASCALL-RICHARDS STEAM GENERATOR.

not only not an obstruction to the heated gases in their passage to the bottom of the boiler but, on the contrary, act so as to create convection currents in the heated gases, which aid in bringing all the heat available in them in contact with the boiler surface proper. Expansion headers with slip joints at the rear end of the boiler provide for expansion and contraction of the generator pipes and thus keep them perfectly straight. The partitioned water box at the front end dispenses altogether with the brick arch in front of the boiler. By its construction the device can be applied to any existing boiler and entails no change in the conditions of firing or running the boiler.

The Company claim that by the attachment of their generator, an increase of from ten to thirty-three per cent. in the capacity of the boiler can be effected. The generator is manufactured by the Hascall-Richards Steam Generator Company, of No. 36 Bromfield Street, Boston, Mass.

PHILADELPHIA NOTES.

THE PHILADELPHIA ELECTRICAL EQUIPMENT CO. has been formed with headquarters at 816-18-20 22 Cherry street. It is prepared to handle all classes of business that may offer under the head of electrical repairing and which will include dynamos, motors, lamps, transformers, &c. M. A. Rettew is president; E. T. Watts, vice-president; A. Y. Laidlaw, general manager; and J. R. Rettew, secretary and treasurer. Mr. J. H. Maxwell is also connected with the concern. The company has a well equipped machine shop.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE

Electrical Engineer.

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CHARGING STORAGE CELLS FOR SIGNALLING PURPOSES.

BY

HAVING found it necessary to overhaul the signalling systems of several large buildings, I realized after many annoying experiences, that some form of battery was necessary which would prove more reliable than the primary cells usually supplied for this service.

In pursuance of this idea, I employed storage cells, generally arranging them in two sets, one set being charged while the other is discharged, alternating this arrangement as occasion required by means of a double pole-changing switch. This arrangement worked satisfactorily with the exception that on several occasions, the attendant having failed to move the switch at the proper time the batteries were entirely discharged. In order to overcome this defect, I designed a switch, which, operated by the starting and stopping of the dynamo, would automatically change the sets.

The engraving, Fig. 1, shows the general appearance of the switch as now constructed. Fig. 2 shows the connections, double circles representing mercury contact cups; solid double lines, the connections with the switch levers in one position; and dotted double lines, connections with the levers in the other position. B^1 and B^2 are the two sets

FIG. 1.—SWITCH FOR CHARGING STORAGE BATTERIES FOR SIGNALLING WORK.

of battery; D shows the dynamo, R a small resistance and M the operating magnet.

The switch really consists of two switches mounted one above the other. The upper one is the pole changer and is operated by the lower one which also breaks connection between the dynamo and batteries when the voltage of the former drops below the proper point. Projecting through the slate base of the upper switch is a small rod, sliding in a tube, its lower end impinging on the lever of the lower switch and adjusted so as to be moved by it, and carrying at its upper end a small spring-controlled pawl which engages with a three pronged ratchet fastened to the shaft of the upper switch.

The operation is as follows: When the dynamo is up

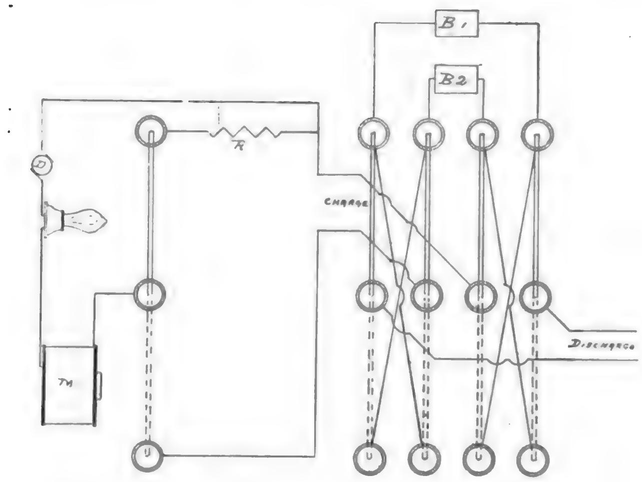

FIG. 2.—METHOD OF CHARGING STORAGE BATTERIES.

to the proper voltage the magnet M is energized and the lever of the lower switch moved, closing the charging circuit. The contacts of this switch being adjusted to preserve the continuity of the circuit during the lever's movement, a momentary short-circuit would occur were it not for the resistance R.

When the dynamo is stopped, the magnet M loses its magnetism and the lower switch-lever is returned to its position of rest by a spring, raising by this movement the pawl which engages with the ratchet and rocks the upper switch, so reversing the connections. This ratchet arrangement changes the position of the upper switch each time the dynamo is stopped. Direct electro-magnetic means were first used for accomplishing these reversals, but the ratchet giving a slightly cheaper construction was finally adopted.

While the lamp, which is used as resistance, suffers a small loss of candle-power, this loss is not so great as to prohibit its use for illuminating purposes.

ELECTRICAL CENSUS COUNTING.

The Russian government is about to undertake some very elaborate and thorough census work, and will do its counting by means of the ingenious electrical apparatus of Dr. Herman Hollerith, of Washington, which was used in the last American and Canadian censuses with great success. It is said, however, that perhaps the Russian government may get its Hollerith machines from Austria, where the system was also adopted in 1891, but where the inventor's latest ideas have not yet been introduced. For this reason, the order may still come direct to this country.

POWER TRANSMISSION.

DIRECT VS. ALTERNATING CURRENTS FOR LONG DISTANCE TRANSMISSION.—III.

(*Concluded.*)

BY

Wm. Baxter Jr.

THE only limit to the electromotive force we can use in either system is the insulation. In other words, we can use just as high an electromotive force as we can successfully insulate. In a direct current system we have to deal with a constant electromotive force, while in the alternating we have a pulsating E. M. F. The strain on the insulation is greater with a pulsating or alternating electromotive force than with a constant electromotive force, just the same as the strain is greater on a tank with a pulsating than a constant pressure. It follows, therefore, that if we can successfully insulate any given alternating electromotive force, we can at least insulate just as high a constant electromotive force, and should be able to insulate a somewhat higher one. Now the maximum electromotive force of alternating currents is about forty per cent. above the effective electromotive force; hence the insulation must be able not only to stand against the working or effective E. M. F., but also against the maximum, which means that for any given electromotive force used in a transmission system the insulation for the alternating current must be about 40 per cent. higher than for the direct current. We can also put this in another way and say, that insulation that will successfully withstand an alternating current of ten thousand volts, would, with equal success, withstand a direct current of about fourteen thousand volts.

These statements of well known facts show that with the direct current system we can use about 40 per cent. higher electromotive force than with the alternating without putting any greater strain on the insulation.

Although with the same character of insulation, we can use a much higher electromotive force in the direct current system, that fact will not help us much unless we can construct generators and rotary transformers that will withstand a very great potential difference. It may be found by practical experience that an electromotive force of, say, fifteen thousand volts, can be used in an alternating system; then so far as insulation is concerned we should be able to use over twenty thousand volts with a direct current. But the question would naturally be asked, Can we make generators for such an electromotive force? We can certainly insulate them if we can insulate an alternator for fifteen thousand volts. The only point about which there can be any uncertainty is the commutator. We know from experience, that commutators will run with very little sparking, in "arc" dynamos working at electromotive forces varying from three to four thousand volts. We also know that these commutators work under great disadvantages, because the requirements of these machines are such that the difference of potential between the segments of the commutator at the points where the brushes bear must be considerable. Arc dynamos are regulated by varying the electromotive force. This is accomplished, in machines of the type we are considering, by rotating the brushes around the commutator through a considerable arc. Now, it is evident that to cut down the E. M. F. of a machine from four thousand to two hundred volts, by rotating the brushes, there must be a considerable difference of potential between the commutator sections over which the brushes sweep, otherwise there could not be much reduction in E. M. F.

If then dynamos are made that work at three and four thousand volts, with practically no sparking, notwithstanding that the requirements of these machines are such that they cannot be designed with a view to giving the least possible spark, it must be conceded that machines for a very much higher electromotive force can be made, if not required to run under such unfavorable conditions.

There is no difficulty whatever, in my judgment, in constructing a constant potential generator for fifteen or twenty thousand volts that will not spark on the commutator. All that is required is to so proportion the parts that the difference of potential between the commutator sections at the points where the brushes bear shall be so low as to be incapable of making a spark. It may be said that machines made for such high electromotive force, unless of very large capacity, would require very fine wire for the shunt coils. But in answer to this it may be said that it is not necessary to use shunt coils. The same result can be obtained in other ways, which admit of the use of large wire.

Whether generators of fifteen or twenty thousand volts could be made that would be thoroughly successful in practice is wholly a matter of opinion. But even if we grant that they could not be made, we would still be able to supply the line with a high electromotive force, as there would be no difficulty in using five or six generators of three or four thousand volts each, coupled in series.

We, therefore, see that if we cannot obtain as high electromotive force as we require from one machine we can get it by using a number of smaller ones. A number of small machines would cost more than one large one, but the difference would not be enough to bring the cost of the direct current plant up to that of the alternating, because the same amount of copper in the line would transmit forty per cent. more energy with the direct current system.

One of the advantages claimed for the alternating system is that the generators and motors do not require commutators. Another is that the transformers are immovable masses of metal. Although transformers used for lighting purposes are immovable masses, those used for motor service are rotating machines, just about the same in design as the direct current transformers.

Now as to the commutator, it is true that years ago this part of electric machines was very troublesome and perishable, but such is not the case at the present time. Formerly it was unusual to see a commutator entirely free from sparking. Since those days we have found out how to proportion machines so as to avoid sparking. We have also greatly improved the construction of commutators. At the present time a commutator that sparks is the exception, and not the rule, and in point of durability they can be classed with the most substantial parts of the machine. There are any number of railway generators running to-day that have not worn down the commutator over eight or ten hundredths of an inch in the last three years. As these commutators have an available wear of about one inch, it follows that they will last for thirty or more years. Any part of a machine that will last that long may be considered thoroughly substantial; therefore any advantage claimed for alternating machines on account of their not requiring commutators is imaginary, and when weighed by the results obtained in actual practice dwindles into insignificance.

In making a retrospective summary of this article we can draw the following conclusions: First, that in point of adaptability to commercial requirements, the alternating current is far behind the direct, while the latter can be used with perfect success in every department of the electrical industry; the former is only available for incandescent lighting. It is true that we expect that the alternating system will eventually be made as flexible as the direct, but it is not so at the present time, and even when it is developed to the highest state of perfection, all we will be able to claim for it will be that it is just as good as, but not superior to, the direct current.

Second, that as to efficiency the alternating system, as now being installed, is very low and not equal to the direct current system. If in the future the step-up and step-down transformations are dispensed with, better results will be obtained, but the improvement will not be sufficient to put the system in the lead, for the reason that the direct system can use an electromotive force equal to the maximum electromotive force of the alternating current, which is about forty per cent. above the effective.

Third, that the cost of plant will be greater with the alternating system, even if the step-up and step-down transformers are discarded, owing to the fact that the direct system can use a higher electromotive force, and thereby make a very great saving in cost of line, this saving being more by far than any difference that might be in the cost of generators and transformers.

The above statements are based upon the supposition that in transmitting current over very great distances, the highest electromotive force should be used that can be successfully insulated. If difficulties are encountered in making apparatus that will work well at these high electromotive forces they will be combated until a practical means of overcoming them is found. Even in the present state of the art the direct current system can be used at the highest electromotive force that can be successfully insulated. This can be accomplished by connecting in series a number of generators developing three or four thousand volts each. Although the arrangement might be looked upon as somewhat crude, it certainly would work well

Whether the alternating current can do as much to-day is by no means certain, but even if it can that is no proof of superiority, in fact, not even of equality, for the very simple reason that we can use direct electromotive force equal to the maximum E. M. F. of an alternating current, and inasmuch as the effective electromotive force is considerably below the maximum, the direct current must have the advantage, unless there are objections in other directions that can offset the gain that can be made by using a higher electromotive force.

UTILIZATION OF WATER POWER AT TOLUCA, MEXICO.

Messrs. Henkel, of Toluca, have closed a contract with Messrs. G. and O. Braniff, of the City of Mexico, for the installation of the necessary plant for supplying Toluca, through the agency of a water power ten miles distant, with electrical energy by day and with electric illumination by night. The water-course to be utilized is one of the many that descend from the slopes of the great Nevado de Toluca, and has long been used under the name of the Caño del Molino for running a flour mill. For the purpose of generating electrical energy, the Caño is to be tapped at a given point, and a certain portion of its waters conveyed through 2,000 ft. of piping to a 350 H. P. Girard turbine. The generator is to be supplied by the Westinghouse Company, and is to be of the Tesla polyphase type. It will be the first one of its kind to be installed in the Republic. By night the plant will supply 8,000 16 C. P. incandescent lamps for the lighting of the city of Toluca, and by day all the power needed for the manufacturing enterprises of the same city,—cotton and woollen mills, breweries, etc.

THE VERSATILE ELECTRIC MOTOR.

SOME idea of the diversity of uses to which electric motors are now being put and the rapid spread of electricity in different directions may be gathered by glancing at the list of orders for motors received in the Power and Mining Department of the General Electric Company, during one month this summer:—Operating mining machinery, shoe factory, operating a yarn factory; a tannery; a powder mill; a watch factory; iron working machinery; a foundry; hoists for electric cranes; ventilator on a gun boat; propelling electric launches; the operation of elevators; blowing church organs; operating woolen mills. These orders are scattered throughout the following states: California, Colorado, Indiana, Ohio, Connecticut, Michigan, Pennsylvania, Rhode Island, Wisconsin and New York; Lima in Peru and Rio de Janeiro in Brazil.

"I enclose check for a cloth filing case wanted for your admirable 'Data Sheets.' Only one fault to find; don't get enough."—A. J. Volbrath.

ELECTRIC LIGHTING.

THE LUMINOSITY LIMIT OF THE HYDRO-CARBON FLAMES.—I.

BY DR. W. H. BIRCHMORE.

The great differences in the efficiency of the flames of the various hydro-carbons in common use as sources of illumination are matters of everyday observation to all the users of artificial light who come in contact with them; but beyond the academic discussion of the thesis that "the brightness of any flame is a function of the combustion temperature," very little has been done to elucidate the matter. Seeking a road toward higher studies I found my way barred by the need of more exact information in regard to certain phenomena of flames, both as to what took place, and why it occurred, and for this need was forced to do an amount of interesting work in order to "pioneer" my way. In doing this there was presented to my notice a series of facts in relation to hydro-carbons in the process of combustion, which do not seem to be so widely known as the interests of many demand that they should be.

The changes produced in hydro-carbons by heat.

If we heat a hydro-carbon, methane for instance, we by hypothesis set in motion an intra-molecular vibration between atom and atom, by which a tendency is given for the centrifugal impulse to grow stronger and stronger until it destroys the cohesion of the molecule and frees the atoms, each from the grasp of the others. If the hydro-carbon is diffused in a sufficient amount of air, or of oxygen, that the freeing of one series of links and the closing of another can take place instantly the hydro-carbon is said to "explode"; if the amount of oxygen or air is less it is said that the hydro-carbon "burns"; under certain circumstances it "smokes." But if, in place of methane, we have other hydro-carbons the phenomena associated becomes very complicated, and intimately involved with this question of the limit of luminosity. The questions involved are physical, rather than chemical, and yet they are discussed almost entirely from the chemist's standpoint. This is the more unfortunate as the enormous advance that has been made in the knowledge of the chemical constitution of the hydro-carbons, joined to the fact that the formulæ are as interesting subjects for speculation as are the things themselves for study, has overburdened the pages of school books with diagrams which in spite of the cautions of their authors have suggested physical notions, and the idea is present in the minds of many, I know it by conversation with them, that there is a mysterious connection in shape and size, as well as in weight, between a formula and the thing which it stands for; it would be as rational to say that a mouse is larger than a man because there are five letters in mouse and only three in man.

All the changes which are produced in a molecule by heat tend to its rupture, and the result that will follow that rupture depends upon the environment at the instant when it occurs. If oxygen be present a part or the whole may unite with it and burn; or a part may burn, another part be precipitated, and still another part form new molecules. If oxygen be lacking, either one of two things may happen; the original molecule may re-form, or new molecules of various sorts may be constituted. There is one physical tendency that is invariable, however, the new gas formed will have a less easily broken molecule than the old.

The physical changes involved in breaking a molecule.

We all know that water makes latent many heat units when it changes to a gas, but usually we pay no heed to the amount made latent when the molecule is changed to atoms, and yet all the enormous amount of heat that is given by the oxy-hydrogen blowpipe is only rendering sensible the amount of force which is made latent when the water is decomposed into its gaseous constituents. The force applied to water to make steam is used in inter-molecular motion and change, but that which is applied to part the molecule to atoms is intra-molecular, and is used in motion between atom and atom.

In addition to that which parts the atoms, still more is needed; that which is used in the work of expanding the gases to the bulk they had before they were combined, and if this is not given from outside the atoms expand by their own elasticity, and chill themselves in the process. It seems odd to think of a white hot flame as being made up of "chilled carbon," but I think it possible to show that the word is well chosen.

In experimenting with hydro-carbons methane has always been a favorite, partly because it is easy to prepare, and partly because it is of a simple molecule. It is a saturated hydro-carbon, and is not attacked by oxygen until the (CH_4) is broken to C, H, H, H, H, under which circumstances it has used up two portions of energy, usually in the form of heat, (*a*) that used in parting the atoms, (*b*) that used in expanding them; it has increased in bulk 2½ times.

This change can be produced at will by heating methane, and

the method of heating makes absolutely no difference in the results, if the needed conditions are preserved in each experiment. Precisely the same results are reached by leading methane mixed with oxygen and nitrogen through a heated platinum tube, or by driving sparks through the mixture with an induction coil. A certain uncertainty hangs over the result of the experiment when the mixed gases are lead through the tube. If the temperature is rightly managed the methane when passed alone, without air, will burn with an intense white light on reaching the air, but if the tube is overheated the carbon will deposit inside the tube and the flame will be non-luminous and almost pure hydrogen.

The best results that I have attained were reached with an apparatus made as follows: Two coils of rather thick platinum wire were made around a tube of the same metal, ½ mm. in diameter and 2 cm. long. These were connected to dry, Mesco cells in such a way that either one could be heated separately, either would make the tube incandescent, and the temperature was under the most perfect control.

In working with the induction coil and the explosion pipette the results were as satisfactory, but the conditions are much more complicated, and the results obtained will serve to pioneer the way, if no more, at present.

The apparatus used was as follows: An induction coil said to give a one half inch spark was connected with three or four Mesco cells; from the coil wires were taken to the condenser, which was so arranged that it could be entirely cut out, or the tin-foil surface be turned in by units of 10 sq. cm., up to 1 sq. metre. From this, wires were carried to the explosion apparatus, consisting of a "Toepler pump," with bulbs holding various amounts, and a distribution apparatus.

The intensity of the spark when the apparatus was used to its maximum efficiency may be judged from the fact that it would give an iron spectrum. The wires of platinum in the explosion apparatus were too large to be heated by the current, or to in any way modify the spectrum, although discontinuous spectra of sodium would appear as ghosts when very "fat" sparks were passed.

In experimenting with methane I at first attempted to decompose it at atmospheric pressure, but no liberality in sparks, or time, seemed to produce any result except to warm the bulbs, and I had concluded that my labor was in vain, when a chance change in the relative positions of the apparatus showed the carbon and hydrogen lines both at the same time in the spectroscope. Here was the clue; the molecule (CH_4) was broken into C, H, H, H, H; but the pressure of the surrounding molecules prevented the separation of the atoms and methane was instantly reformed. Next I tried reducing the pressure, exhausting the methane to about three pounds, or rather less than one-fifth of an atmosphere, and obtained just the same result as before. Then I let in mercury to form a mirror, and exhausted to 78 mm., and set the coil at work; after some hours' patient waiting I found that a deposit, manifestly carbon, had produced an iridescent surface, and much to my satisfaction the pipette proved to contain free hydrogen. The explanation seems to be this: The atoms set in motion by the spark were able to get far enough away from each other to sort themselves into carbon and hydrogen. The only physical evidence of the changes is the appearance of the lines in the spectrum.

Extending these experiments from methane to the other hydrocarbon gases a similar series of results can be obtained, but to be sure of my ground I repeated a certain number of the classic experiments, and then turned to the hydro-carbon vapors, anticipating a quite similar series of results, only to meet defeat at every turn. When I found the clue I went back to find my "forgetfulness," but I have not found it yet; and I think I may state my conclusion and the results of my experiments very much as follows: "If a mixture of fluid hydro-carbons be heated in the presence of air the various vapors begin to rearrange themselves into molecules of higher and higher breaking temperature; beginning with some complex molecules whose breaking temperature is below that at which free hydrogen will unite with oxygen diluted with four times its bulk of nitrogen. Those sufficiently heated unite with oxygen and burn, heating and breaking others. The gases, or vapors, thus formed invariably take up more room, and demand heat with which to do this work of expansion, which heat they obtain from the carbon molecule which is precipitated and being hot gives a more or less intense light." If this statement seems obscure it can be made less so by lighting a "tar barrel" and watching the resulting phenomena.

ARC LIGHTS AT THE MASTHEAD.

Superintendent Fowden, of Atlantic City, N. J., has purchased for his electric light and power company the two huge masts of the schooner "Metcalf" that went to pieces on the beach near the Iron Pier recently. The masts will be erected where they are now lying at the corner of Pacific and Kentucky avenues to support the company's wires. It is thought they will be of sufficient height to permit the moving of ordinary sized buildings on the avenues without having to cut the wires as has been done heretofore.

THE PORTIS PROCESS OF TAPERING CARBONS FOR ARC LAMPS.

In a patent recently issued to Mr. Thomas G. Portis, of St. Louis, Mo., the inventor describes a type of arc carbon claimed to possess increased life. The invention is based on the fact that toward the latter part of a run in arc lamps the electromotive force increases perceptibly and more energy is available at this time to dissipate a coating upon the electrodes. To absorb this additional energy, Mr. Portis increases the thickness of the carbon taperingly from the arc end to the other end by a coating, as shown in the accompanying engraving.

This sort of a coating may be deposited on the electrodes by

THE PORTIS TAPERING CARBON.

placing the arc ends of the carbon in a holder for plating and then immersing them in a suitable electrolytic bath. After a sufficient minimum amount of metal has been deposited thereon, the carbons are gradually drawn out of the bath, so that the ends remote from the arc will be heavily coated, the coating increasing in thickness progressively from the arc end.

Mr. Portis claims that with this type of carbon he has been able to materially increase the life of Hazeltine coated carbons. He attributes the greater available energy in dissipating a coating at the latter part of a run to the fact that the carbons being shorter their resistance is less, and the upper carbon being materially reduced in weight the lifting magnets controlling the upper carbon do not have to expend so much energy as before in maintaining the upper carbon in its raised position.

THE CRAWFORDSVILLE, IND., MUNICIPAL PLANT. —FANCY AND FACT.

What our electric light plant cost is something past finding out. At least so far no one has ever been able to find out. The *Argus-News* for a long time took it for granted that everything was all right, but a little investigation goes to show that everything is all wrong. In the first place the plant was bought for $55,000. Last year the receipts were $8,259.27. Expenditures $14,827.01. Excess of expenditures over receipts $6,567.75, making the estimated cost of each light $45.61. This looks well enough on its face but is figured from a wrong basis. There should be added to this the interest on the plant beyond the $45,000 borrowed money to pay for it. As we said what that is no one knows. It runs from $30,000 to $50,000 at lowest calculation. Suppose it is $45,000, the interest would be $2,625.00 which added to the $6,567.75 would make $9,192.74. Now add 10 per cent. for depreciation of plant annually and you have a plant costing over $10,000 a year and only supplies a few lights besides the arc lights. These cost the city $7.25 each last month; 145 of them cost $1,041.25 for October.—*Crawfordsville News.*

So much for the fact. This is what "Prof." Frank Parsons puts forward in the *Arena*, as to the "beauties" of municipal plants:—

Competition and regulation have failed and must always fail. One relief only is left; there is no escape from private monopoly but in public monopoly. That, with a good civil service solves all the difficulties, and it is the only thing that can solve them because it is the only thing that can remove the antagonism of interest which is the taproot of the evils of monopoly. When we examine cities that have already adopted this solution, we find economy, impartial administration, regard for public safety, efficient service, and a decided gain for good government—all the evils of private monopoly overcome, and no new evils introduced, if the civil service is guarded, which it is our duty to see done for the sake of good government in general, as well as in order to enjoy in the fullest degree the benefits of the public ownership of monopolies.

A NOVEL LIGHTING TOWER FOR SPRINGFIELD, MO.

Councilman Gottfried, of Springfield, Mo., is promoting a scheme to erect a novel electric tower on the city square, and has already received several hundred dollars in subscriptions. The tower will be built on a bed of concrete seven feet deep and twelve feet square. The four supporting columns of steel will extend through the concrete and will be bolted on the under side. A steel plate twelve feet square will cover the bed of concrete. The upper structure will be of angular steel, in preference to steel tubing and will be strongly built.

At an elevation of sixteen feet a band stand twelve feet square will be built. This is to be reached by a ladder. When the band goes up, the ladder is thrown down, so that the populace can't get at the musicians.

At a height of thirty-two feet, the braces for trolley wires will be placed and finally at the elevation of fifty-five feet, a statue of the Goddess of Liberty in bronze, will look over toward the county jail and point her torch toward a newspaper office.

THE GREGER NOISELESS MANHOLE COVERS.

The principal cities of the country have long since by ordinance compelled the taking down of overhead wires, and their placing in conduits, and smaller cities are rapidly following this line of action. In some instances electric companies have, of

Fig. 1.—Greger Noiseless Manhole Covers, Philadelphia. A, A, A, Greger Manholes. B, Old Style Manhole.

their own accord, undertaken this work, as the cost of maintenance, once the wires are buried, is so small that it has been shown to be a profitable investment. The necessity of maintaining accessibility to the wires has, of course, involved the construction

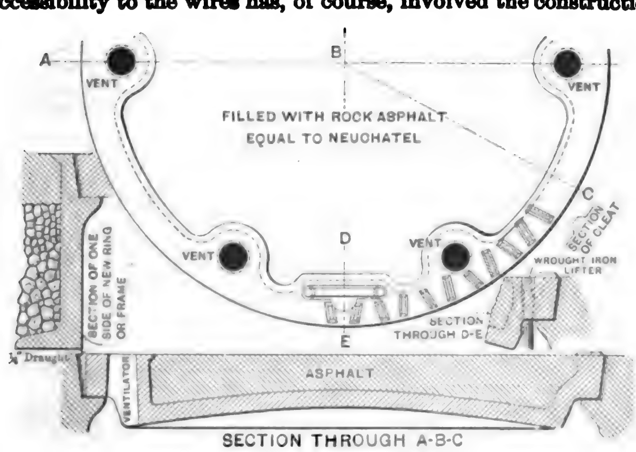

Fig. 2.

of man holes and these require covers. The styles of covers thus far used on electric manholes have not by any means been an ornament to the streets in which they are laid, especially in those paved with asphalt or granolithic, or vitrified brick. But most of all have these manhole covers been a nuisance, by the loud and disagreeable noise, which they create whenever a vehicle passes over them. That a manhole cover can be constructed which will not mar the beauty of the finest pavement, and on the other hand prove as noiseless as any other part of the street is evidenced by the results obtained in Philadelphia with the Greger noiseless manhole covers, over 1,000 of which are in use in that city at

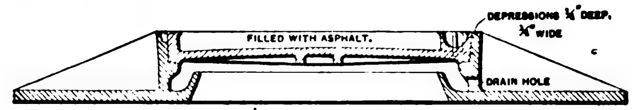

Fig. 3.

the present time. This manhole cover was designed by Mr. Thos. P. Greger, Inspector for the Board of Highway Supervisors, and in charge of the underground electrical construction in Philadelphia, and the covering is an outcome of a direct study of the subject based on a practical experience of nearly ten years under that pioneer in underground wire work, Chief David R. Walker, of the Philadelphia Electrical Bureau.

Perhaps no better illustration of the difference between the old style covers and those of the Greger type could be used than is presented in the accompanying engraving Fig. 1, which shows at A A A, three of the Greger noiseless covers, and at B the old style of construction. As may be seen the Greger covers are circular and leave the asphalt or other paving surface almost continuous, so that the vehicle rolling over them creates no noise

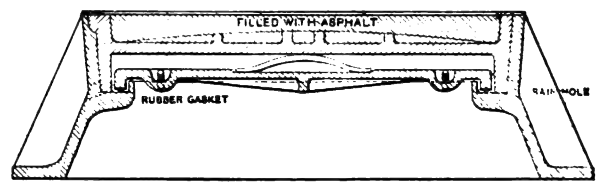

Fig. 4.

whatever, the tops being filled flush with the surrounding street surface.

Various types of these covers have been designed by Mr. Greger, which are adapted to varied uses. Thus, for example, Fig. 2 illustrates a Greger cover on an old sewer manhole frame. Provision is made for ventilation by six vents, distributed evenly around the circumference. Of course the same type can be made non-ventilating by casting the cover without the vents. This form of cover has been adopted and is being used generally in Philadelphia, on the streets that are covered with improved pavements, of which there are 275 miles of Belgian block, 65 miles of vitrified brick, and 115 miles of asphalt.

Another form, shown in Fig. 3, is adapted for general electrical construction, making a water tight manhole, and designed so

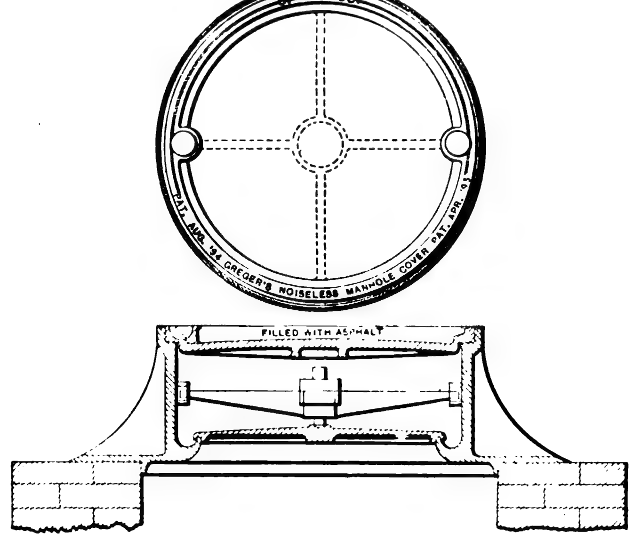

Fig. 5.

that it can be arranged to cover a considerable space; being shallow, it allows of considerable head room. It will be noticed that the water entering between the lid and the frame is caught up by a circular lip on the inside of the frame and runs out at the drain hole indicated, finding its way into the sand or broken stone surrounding the cover, and hence does not enter the man hole. A gasket packing is therefore necessary in

many cases. This type of cover is used by the Brush Electric Co., the Edison Electric Light Co., and the Columbus Electric Light Co., in Philadelphia.

The engraving Fig. 4 shows a Greger manhole topped with a double lid and an inside lid provided with a spring and gasket. The upper lid bears down upon the spring and keeps the inner lid in place, weighting the inner lid sufficiently to make a water tight joint at the gasket without bolts or screws. This type of manhole has been used by the Edison Elec. Light Co., the Brush Electric Co., and the People's Traction Co., in Philadelphia. The Hestonville, Mantua & Fairmount Park Railway employ the

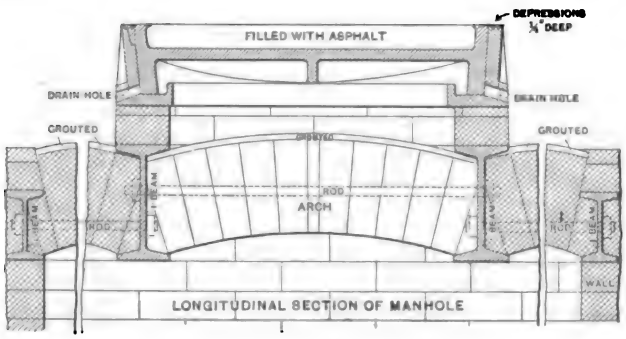

FIG. 6.

Greger noiseless cover on their old style frames, Fig. 5, in which the seal is effected by a bar and screw.

Where it is desired to make a large manhole, the type of cover shown in Fig. 6 has been designed by Mr. Greger. This manhole it constructed of I-beams, bolts and brick arches, and a number of these have been constructed by the Edison Electric Light Co., and the Brush Co., in Philadelphia. These are also provided with the inner circular lip for catching and draining water.

Where the wires are run under the foot ways, Mr. Greger has designed a style of cover which is in use by the Columbia Electric Light Co. in Philadelphia, and which is illustrated in Fig. 7.

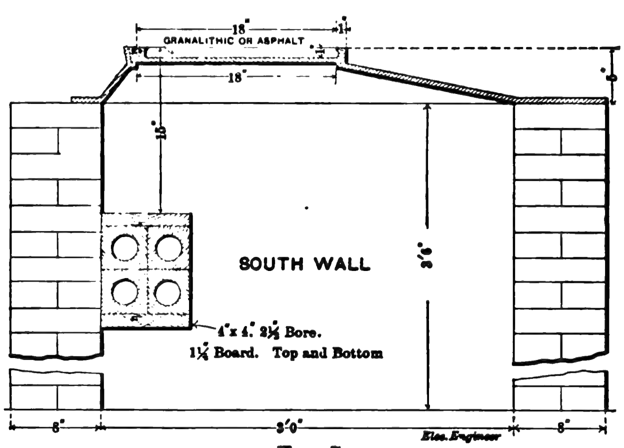

FIG. 7.

The top of the cover is only 18 inches in diameter, and one of these can be placed at the junction of every other house, from which the service can be tapped to the house on either side. The tops of these manholes are also filled with asphalt or granolithic pavement.

The great success of these manhole covers, attested by their large and increasing use in Philadelphia, ought to lead to their introduction in other cities

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"MONKEY BUSINESS."

Municipal ownership of lighting plants is coming to be a mooted question in cities, both big and little, the country over. Probably the monkey business indulged in by private corporations has done more than anything else to bring this to pass.—*Improvement Bulletin.*

CLEVELAND ON ALTERNATING CURRENTS.

IN his message to Congress, President Cleveland says:—"It is not to be forgotten that international trade cannot be one sided. Its currents are alternating."

CAPT. WM. BROPHY says: "I am very much pleased with the 'Data Sheets.' It is only recently I have begun to use them, but will continue to do so from this time on."

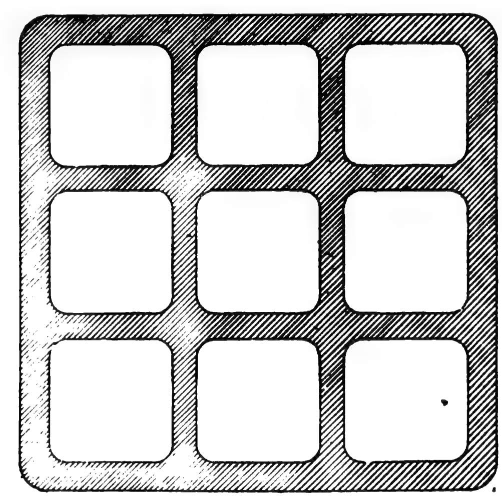
THE McROY VITRIFIED TERRA COTTA CONDUIT.

Notwithstanding the many familiar types of conduit heretofore designed for underground electrical drawing-in systems. Mr. Jno. T. McRoy, 36 S. Clark street, Chicago, comes to the front with a vitrified terra-cotta construction for which he claims features of superiority over all other types of conduit now in use. A transverse section is shown herewith.

The material used is shale, which being primarily subjected to the most thorough grinding or triturating process, is rendered absolutely free from all rough objectionable particles of matter, such as are usually observed projecting from the glazed surfaces of the ordinary clay product, and adapted, when being worked into form, to be compressed to such degree of density as to preclude the slightest possibility of porosity.

The conduit is manufactured in multiple duct form of any desired number and cable-capacity, and in section-lengths of about four feet six inches; the construction being so evenly or regularly proportioned in cross-section as to effectually offset any tendency toward irregular shrinkage of the material while undergoing the process of complete vitrification and internal and external superficial glazing.

In locating the conduit-sections underground, abutting ends



McROY TERRA COTTA CONDUIT.

are first hermetically sealed with approved jointing material and then securely clamped in position, thus avoiding the use of cement or concrete in connection with the work and enabling the installation of the same without difficulty and in perfect shape at any season of the year.

The main points of superiority claimed for this conduit are its indestructible and imperishable character in so far as corrosion is concerned; its capacity for protecting the cables which it carries from the destructive electrolytic action of railway return currents; its freedom from porosity—effectually excluding gases, moisture, etc. from the cables; and its perfect superficial finish, which admits of the drawing-in of cables without abrasion or damage to their outer covering, whether of lead or otherwise.

In the manufacture of the conduit novel and powerful machinery is used, all being designed by Mr. McRoy specifically for such purpose, and being owned and controlled exclusively by him.

CONTRACTS FOR NEW YORK CITY ELECTRIC LIGHTING.

The New York Gas Commissioners have voted the following contracts for 1896: Brush Illuminating Company, 720 lamps at 40 cents per night, and 92 at 45 cents; Madison Square Electric Company, 812 lamps at 40 cents and 10 at 50 cents; Mount Morris Electric Light Company, 361 lamps, 40 cents; Harlem Electric Light Company, 212 lamps at 40 cents and 19 at 50 cents; Manhattan Electric Light Company, 241 lamps at 40 cents; Edison Electric Light Company, 165 lamps at 50 cents.

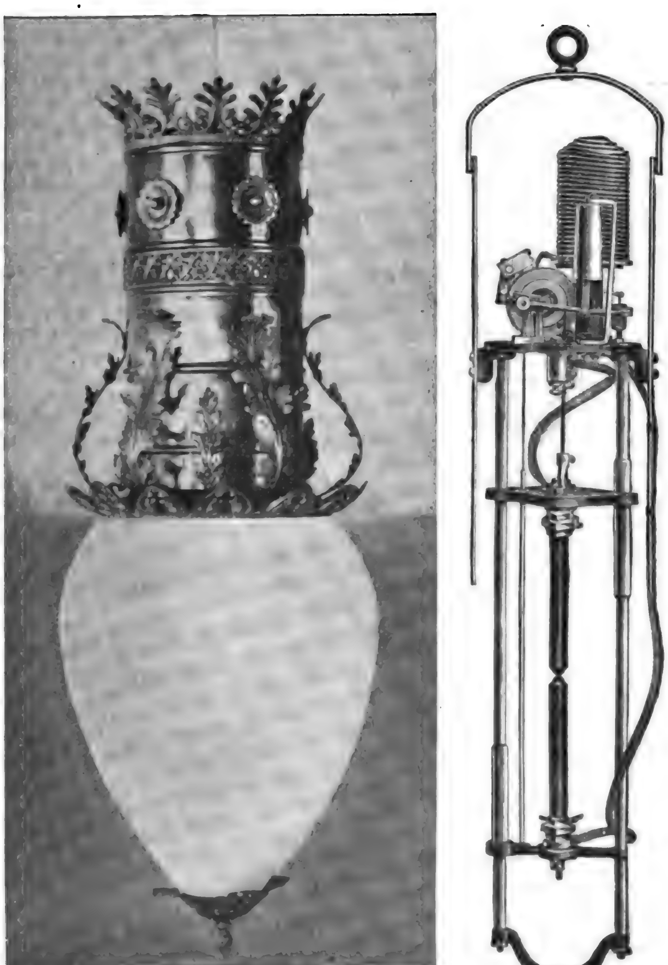
Controller Fitch is anxious to have the electric lighting system extended to all parts of the east side as recommended by the Tenement House Commission. He offered a resolution requesting the Corporation Counsel to decide whether the Board of Electrical Control has any legal authority to proceed to construct subways sufficient to double the electric lighting of the city, and he also offered another resolution requesting the Corporation Counsel, in case he found that the Board of Electrical Control had no such authority, to draw up an act to be submitted to the Legislature which will give the board power to lay subways in streets where electricity is needed. The Board of Electrical Control says that it has no such power.

THE FLEMING-SPENCE ALTERNATING ARC LAMP.

UNTIL recently the alternating arc lamp had not kept pace with the rapid development of alternating current appliances in general; but now this type of lamp seems to have been brought to a state of perfection which puts it on a level with the direct current arc lamp.

The accompanying illustration, Fig. 1, shows a lamp of this class recently put upon the market by the Fleming-Spence Electric Co., of 652-660 Hudson St., New York. As may be seen from the view, Fig. 2, which shows the mechanism of the lamp, it is of remarkable simplicity in design, having but a very few parts and these are exceptionally strong and not liable to get out of order when subjected to the hard usage this class of apparatus usually receives.

In operation the regulation is effected by a solenoid with core of laminated iron. This core is connected to the long arm of a simple lever by means of a spring device which effectually takes



FIGS. 1 AND 2.—THE FLEMING-SPENCE ALTERNATING ARC LAMP.

off all vibration from the mechanism, thereby preventing noise. As the core is lifted up into the coil carrying with it its end of the lever, the opposite end of the lever depresses a frame on which is mounted a detent which engages the deep teeth on the periphery of the wheel mounted on the chain drum. This detent, the motion of which is eccentric with that of both the frame and the wheel, as it engages the wheel in its descent turns it backwards to a certain distance, dependent on the quantity of current in the coil, thereby pulling the carbons apart and striking the arc. As the carbons burn away, the core descends and allows the wheel to slip by one tooth at a time, then readjusts itself to the new conditions instantly. This action is repeated continuously.

The lamp will start instantly on its rated current and will maintain it almost absolutely constant. The carbon carriages and guides deserve especial mention. They are so designed that it is impossible for them to stick or bind, either from dirt accumulated on the rods or from their getting out of line.

The hanger is made of spring steel, and projects down the sides of the lamp far enough to allow the mouth of the globe to slip over it. This makes a very neat and effective globe holder.

The company also has an eye for beauty, and has produced from special designs a handsome line of ornamental lamps, one style of which is shown in Fig. 1.

FEED-WATER PURIFICATION AND HEATING.[1]

BY PROF. F. B. CROCKER.

Feed-Water Purification.—The water used in steam-boilers is obtained either from the regular city water-supply, or from some source such as a pond, river, or well. Which of these is best to employ depends upon the circumstances in each particular case; but in almost every instance the question of the purity of the water is an important matter. Almost any water available for use in boilers contains from 10 to 100 grains of solid material per gallon! and since a 100 horse-power boiler evaporates about 80,000 lbs. of water per day of 10 hours, or about 400 tons per month, the accumulation of this material becomes very considerable, being from 75 to 750 lbs. per month, assuming only half of it to be deposited. Impurities in water are of two distinct kinds: First, small particles of solid material mechanically held in suspension, the presence of which is perfectly evident to the eye, forming what is called, in plain language, muddy or dirty water. The other class of impurities are mineral substances dissolved in water, producing little or no change in its appearance or transparency.

Impurities of the first kind can be removed by filtering, or by simply allowing the suspended particles to settle; but impurities actually dissolved in the water can only be eliminated by some process of chemical or physical precipitation. The so-called "hard water" is simply water containing compounds of lime, magnesia, etc., in solution, which are particularly objectionable in water for boilers, since they are deposited as a scale or incrustation upon the interior, and seriously interfere with the transmission of heat through the metal, thereby reducing the efficiency of the boiler, and also introducing a danger that it will become excessively heated and weakened. These deposits in boilers sometimes reach a thickness of half an inch or more, and are extremely troublesome and difficult to prevent, or to remove after they have formed. It is estimated that scale 1/16 inch thick necessitates the use of about 10 per cent. more fuel, 1/4 inch almost 40 per cent. more; and 1/2 to 3/4 inch scale actually doubles the amount of fuel required to generate a given quantity of steam. These facts, and the greatly increased repairs and danger arising from scale in boilers, show the great importance of eliminating it.

Feed-water purifiers of various forms are employed to rid the water of these impurities. They usually consist of vessels or collections of tubes in which the water is heated, the object being to deposit the impurities in the purfier, from which they can be easily removed, instead of in the boiler itself. Indeed, any form of feed-water heater or economizer also acts in the same way.

The chemical treatment of the water previous to introducing it into the boiler to remove the dissolved impurities is not particularly practicable, but in some cases it may be beneficial. For this purpose one may use some substance which, when added to the water, will precipitate the impurities, so that they can be removed by filtering, or by allowing them to settle. For example, carbonate of lime or magnesia is one of the most common impurities in water, but it is only soluble in water charged with carbonic acid; hence if milk of lime or caustic soda be put in the water, the carbonic acid combines with it, which causes the carbonate of lime to be precipitated. The sulphates of lime and magnesia, which next to the carbonates are the most common impurities in water, may be precipitated by adding carbonate of soda or soda-ash to the water. The precipitate, which is a white powder, may be removed from the water by filtration, or may be blown out of the boiler from time to time, and is far less objectionable than the hard adherent scale formed by the sulphates. Deposits in boilers may be removed by the simple operation of "blowing off," which consists in allowing a certain amount of water to escape from the mud-drum, thereby carrying away the dirt and precipitates which tend to collect in it. Actual cleaning with scrapers is necessary if the deposit has formed on the tubes or shell of the boiler, and has reached a thickness of 1/8 or 1/4 inch. There are many "boiler compounds" which are put into the boiler, and intended to dissolve, loosen, or otherwise get rid of the scale. These last remedies are somewhat similar to "quack medicines;" but they are quite popular in places where the hardness of the water gives great trouble, and is often so serious that almost any remedy is welcome. Oak, hemlock, and other barks, logwood and similar substances, are effective in water containing carbonate of lime or magnesia, by reason of their tannic acid, which produces a precipitate that is held in suspension, and does not deposit as scale; but the tannic acid is injurious to the iron, being apt to corrode it. The same objection applies to molasses, vinegar, fruits, etc., which have also been used; but their acetic acid eats away the iron.

Oil is frequently put into boilers to prevent the scale from adhering; but great care should be observed in its use, and it is likely to cause foaming and other troubles. The best oil is a high-grade kerosene; and any oil that is heavy (i. e. has "body") is very objectionable, because it tends to occasion foam, and also forms films or accumulations which prevent the water from coming in contact with the iron, thereby allowing the latter to become abnormally heated producing weak or bulged spots.

Feed-Water Heaters are desirable in every electric-lighting

1. Abstract from paper read before the Henry Electrical Club.

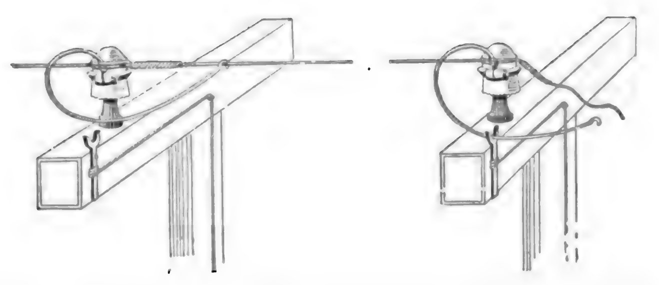
installation, whether it be a large central station or a small isolated plant, in order to save as much as possible of the heat in the exhaust steam, and at the same time avoid feeding the boiler with cold water. The ordinary forms of feed-water heater consist either of a collection of pipes through which the feed-water is passed, and around which the exhaust steam from the engine circulates, thereby warming the feed-water, or the converse arrangement. The feed-water heater introduces no objectionable complication or trouble, being merely interposed in the pipe leading from the feed-pump to the boiler; and it seems to be generally desirable and advantageous for both condensing and non-condensing engines, even when the exhaust steam from the latter is used for steam heating. One well-known type consists of a series of inverted U tubes through which the exhaust steam passes, and around which the feed-water circulates.

Economizers, like feed-water heaters, have for their object the saving of escaping heat and the warming of the feed-water; but in the economizer the heat is obtained from the waste gases on their way from the boiler to the chimney, instead of from the exhaust steam. The ordinary arrangement consists of a series of pipes through which the feed-water flows and around which the products of combustion pass. The economizer of course tends to reduce the temperature of the gases in the chimney, and to that extent decreases the force of the draught. If, however, the gases leave the boiler at a higher temperature than is needed to give sufficient draught, then the reduction in temperature is not objectionable. If, on the other hand, the gases are cooled by passing through the boiler to as low a temperature as is compatible with a good draught, then the economizer is evidently undesirable, unless used in combination with mechanical draught as is done in some instances. As a matter of fact, the economizer is practically an extension of the boiler; but the use of a separate economizer is a much better arrangement than combining it directly with the latter (by making a longer boiler, for example), since it enables the boiler as a whole to be run at a higher temperature and pressure, and avoids the introduction of cold water into the boiler proper. It would, therefore, seem that the economizer is particularly suited to cases where the steam-pressure is high, since the temperature of the boiler, and that of the waste gases leaving the boiler, would be correspondingly elevated.

THE JEWETT AUTOMATIC GROUNDING DEVICE.

THE fierce storm which passed over the country at Thanksgiving time, played havoc with the wires of all kinds and not a few accidents were caused by contact with loose or broken wires. This danger is always to be feared in cities having a large number of telegraph, telephone, electric light and railway wires, and a device to prevent accidents to persons, as well as to obviate the danger from fire by crosses is therefore obviously of value. One of the simplest of this nature which has come under our notice is that known as the Jewett automatic grounding device, illustrated in the accompanying engravings.

As will be seen, it consists of a clamp fastened around the insulator which holds the spring at one end, the other end being



FIGS. 1 AND 2.—THE JEWETT AUTOMATIC GROUNDING SWITCH.

held by the line wire when the line is intact, as shown in Fig. 1. The clamp is also connected with the line by means of the tie wire. One ground wire for each pole with a branch on each cross arm will suffice for any number of lines on a pole. There is a bracket directly under the spring connected with the ground wire.

It will readily be seen that the spring is in contact with the line and the bracket with the ground wire, but out of contact with each other while the line is intact. In case the line breaks the spring automatically contacts with the ground wire bracket, as shown in Fig. 2, and in case of heavy currents like electric light and railway, it shunts the current down the pole, thus rendering the hanging wire dead, or practically so.

The device is especially valuable in the case of telephone and telegraph lines where they cross trolley or electric light wires; one of these switches is placed on each insulator on both sides of the trolley or electric light lines. In case a wire breaks and makes contact with the heavy current wire, it prevents the instruments from being burned out, and renders the lines safe for linemen to work upon. Again, in open circuit fire or police telegraph lines it notifies the office when the wire breaks, so that it can be immediately repaired, thus rendering the line out of service only the shortest possible time. On closed circuit fire and police telegraph lines it serves to keep the circuit intact when a wire breaks, thus insuring fire alarm service at all times. The device is manufactured by G. A. Jewett, of Chicago, Ill.

TELEPHONY AND TELEGRAPHY.

EXPERIMENTAL USE OF THE ESSICK PAGE PRINTING TELEGRAPH FOR TRANSMITTING INFORMATION IN SEA-COAST ARTILLERY FIRING 1895.[1]

BY H. C. CARBAUGH, FIRST LIEUTENANT, FIFTH ARTILLERY, U. S. A.

The Essick instrument, by the aid of electrity to control its machinery, prints messages—on a sheet of paper five inches wide —and is operated, in a manner similar to a typewriter, so that the operator always has before him, in ordinary printed figures and alphabetical characters, an exact duplicate of what is being received at the several stations along the line.

The transmitter, shown in Fig. 1, with the generator of electricity may be regarded as forming one part of the system and the receivers, one of which is shown in Fig. 2, connected by line wire form another,—the telegraph line.

In our experimental use of the instruments a transmitter and a receiver were placed in each of two stations about 1900 yards apart. Each pair was connected with another and separate pair in an intermediate or plotting station thus forming two independent systems or lines. The two pairs in the plotting station were united in one case. They required but one operator.

A gun circuit was also set up with two stations, each, having a receiver on a tripod. These receivers were connected in series with another receiver and a transmitter in the plotting station. As each transmitter must have its own source of electricity this arrangement gives five complete circuits.

The construction of the instrument is such as to require about one-fourth of an ampere of current with which to be operated. It was decided to use a dynamo, running at a speed to give 70 volts electromotive force, for generating the required electricity. Each transmitter was accordingly connected with it by wire leading to a central switchboard, in the plotting house, to which the current from the dynamo was led.

The resistance of each circuit was then fixed at about 280 ohms, by adding thereto lamp resistance. This was necessary in order to give with the assumed 70 volts the required ¼ of an ampere for each circuit.

The resistance of a receiver is about 20 ohms and that of a transmitter about 10 ohms. The earth was used as a return line circuit from station "A" to the central switchboard but from "H" it was wire, to prevent short circuit.

The stations being in use for target practice, only a few hours at odd times between June 14th and June 22d could be devoted to getting the instruments in working order and in practicing the operators, who were enlisted men previously instructed in the use of the key-board but who were entirely unfamiliar with the practical use of the machines.

From June 22d to July 3d the instruments were in frequent use for transmitting angular readings in vessel tracking. During this time it was found that with ordinary observers and unskilled operators the angular readings could be taken, transmitted and plotted at a rate to show consecutive positions of a moving vessel at intervals of 25 seconds. The rate being limited to this by the observers. Each angular reading could be transmitted in about 7 seconds and they came in simultaneously from the observing stations.

The following is a specimen of the printing:

E-BATTY 49 YDS OVER LINE SHOT

NEW RANGE 3524 YDS -

M-BATTY 2 YDS SHORT LINE SHOT

NEW RANGE -SAME-

On July 5th the instruments were used for transmitting information in actual target practice. They were so used on various days up to include July 23d. During this time no failure of the instruments can be recorded nor did any mishap occur

1. Abstract from the *Journal of the U. S. Artillery*.

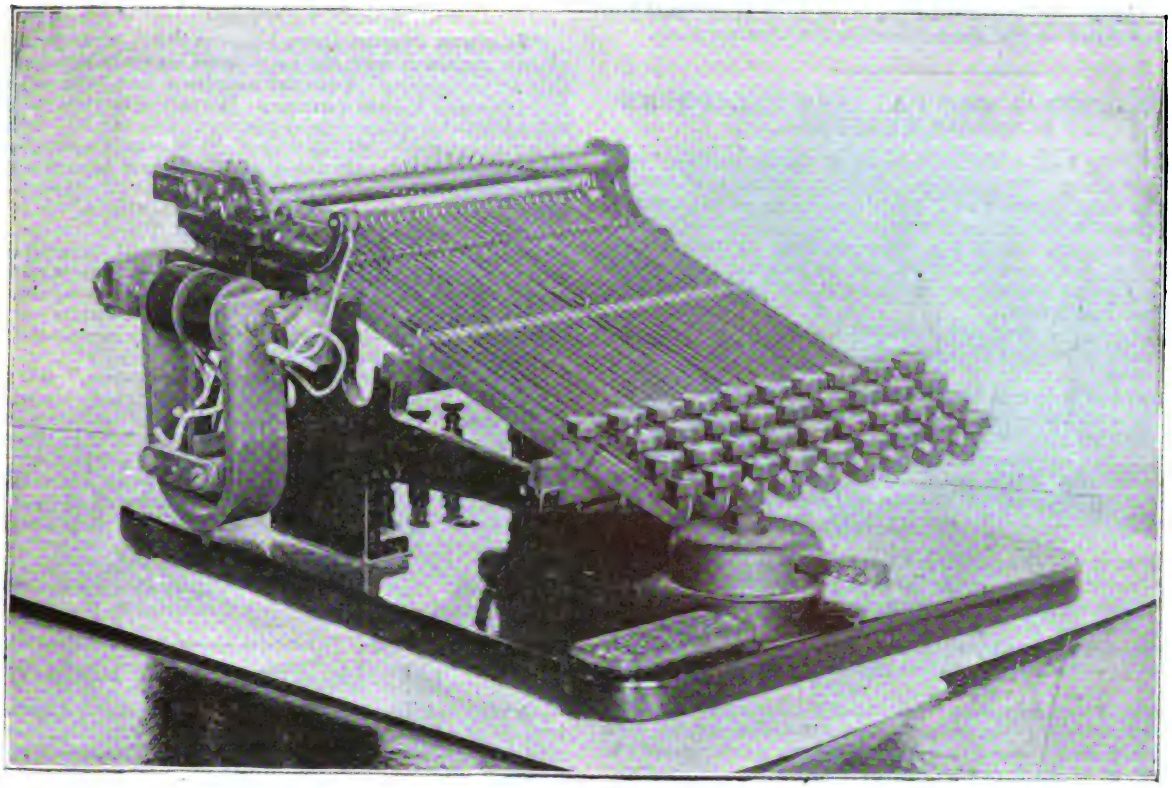


FIG. 1.—THE ESSICK PAGE PRINTING TELEGRAPH.—TRANSMITTER

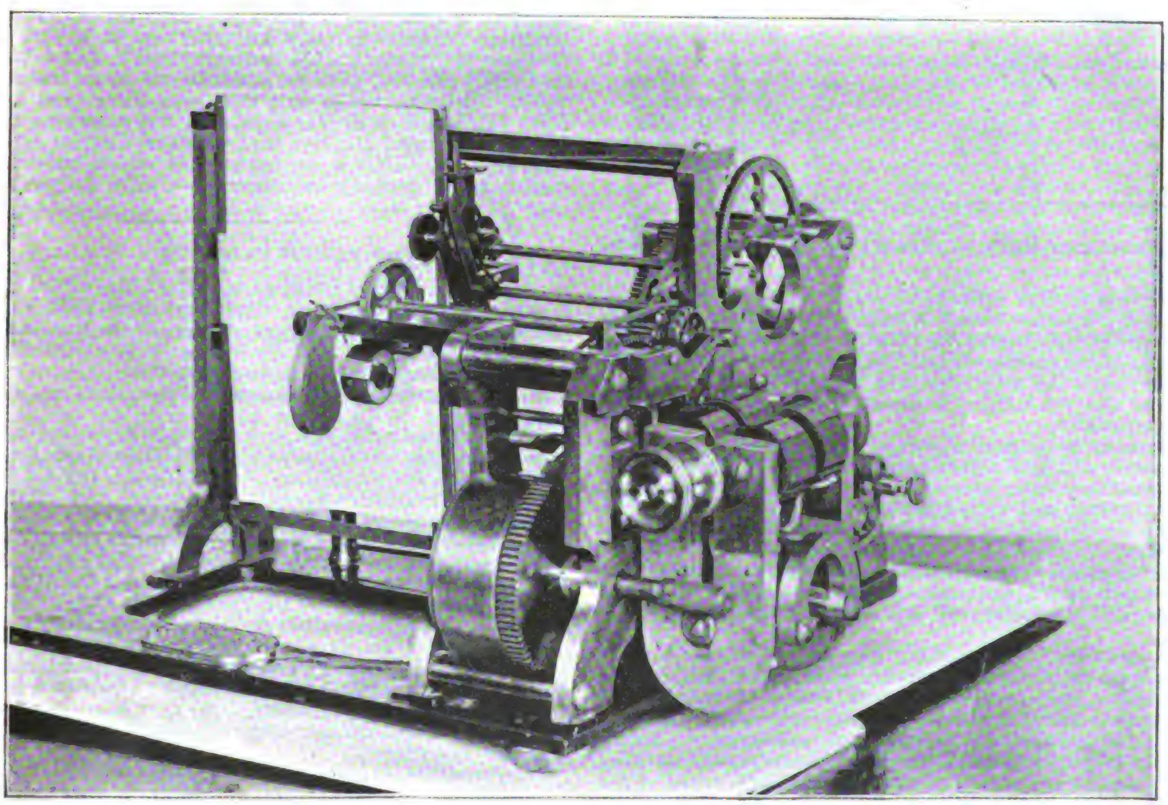


FIG. 2.—THE ESSICK PAGE PRINTING TELEGRAPH.—RECEIVER.

save the breaking of several switch-handles—a defect already remedied. Several times, due to mishaps or misunderstandings in the power house, no current was supplied and the instruments could not be used. The instruments lay idle from July 17th to July 22d. On the latter date as soon as the current was turned on they worked well and continued to do so on that and the following day.

They were used during several thunder storms and rain storms. They were left in circuit several nights when thunder storms occurred, during which the lightning seemed to unsettle the permanent magnets to some extent.

The test of the instruments was under severe service conditions. Those in the plotting house were subjected to over one hundred shocks of discharge from 8″ and 15″ guns used in target practice. The plotting house being partly built on piles, its floor vibrates at each discharge of the gun sufficiently to throw a copper cent about half an inch from the floor.

Neither the instruments in the plotting house nor those at the

guns were affected by the discharge, save that sometimes the paper was dislocated or the wires loosed in the binding posts.

STONE'S CENTRALIZED BATTERY TELEPHONE EXCHANGE SYSTEM.

The care of the local batteries located at the subscribers' telephones, to operate the transmitters, in large exchanges amounts to a very large sum annually and hence means have been sought to furnish current to subscribers' transmitters from batteries situated at the exchange. Such a system has been in operation at Lexington, Mass., for some time with success and it is proposed to inaugurate a similar method of working in one of the new New York telephone exchanges.

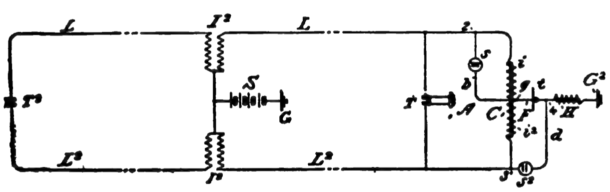
Among the various methods proposed for carrying out such a method in practice we find that recently patented by Mr. John S. Stone, of Boston.

In this method a circuit of low resistance is provided for the supply-current without introducing an induction-coil at the sub-station and without any disturbance of the balance of the metallic talking-circuit, for the impedance of electrolytic cells to disturbing induced currents being, practically, negligible and such current coming upon the line conductors will pass freely to earth at the sub-station through the battery branches of the two conductors.

Referring to the accompanying diagram, S is the common battery having one of its poles grounded at G. L L^2 are the two main conductors of the main talking circuit, both connecting as parallel branches of a single conductor with the source S, as shown, to form the sole main conductor of the transmitter-supply circuit and united at a sub-station A to the two ends of an impedance-coil C.

A conductor F extends from a point g at the middle of the impedance-coil dividing the same into two sections, one for each main conductor, to the earth terminal or return conductor of the supply-circuit at G^2 and includes the transmitter t.

A branch circuit b extends from the point g at one side of the transmitter to a point 2 on the main conductor L, and in the branch is connected a Planté battery s, and a shunt-circuit for



STONE'S CENTRALIZED BATTERY TELEPHONE EXCHANGE SYSTEM.

varying currents is thus established round one section i of the impedance-coil. Another branch d unites the point 4 at the opposite side of the transmitter to the point 3 on the other main conductor L^2 and contains the second battery s^2, forming another shunt-circuit round the second section of coil i^2. The receiving-telephone T of the sub-station is shown as bridged between the main conductors L L^2.

The two main telephone-circuits are connected at a central station by means of a split repeating coil, but this is not essential.

H is an auxiliary impedance-coil placed in the return wire of the supply-circuit to aid in confining the voice-currents to the main talking-circuit and also to assist in maintaining the balance of the circuit.

The number of cells for each battery are so proportioned that their natural potential approximately equals the fall of potential through the coil or section of coil which is shunted by the battery.

In the operation of this system the passage of the supply-current through the transmitter in accordance with well-understood principles determines a steady difference of potential at its terminals as long as the transmitter-resistance remains unchanged; but as soon as the transmitter-resistance is varied corresponding potential differences occur. These varying potential differences cause a succession of complete re-distributions of the potential of the low-impedance conversation-circuit, which is composed of the two conductors L L^2 of the main line in series, and their terminal connections leading through the transmitter t, the electrolytic batteries s s^2, and, as shown, through the two right-hand windings of the split repeating induction-coil I^2. As a consequence, vibratory or voice-currents corresponding to the variations in the resistance of the transmitter are developed in and traverse the low-impedance metallic conversation-circuit to operate the telephone-receiver at the distant station. As shown in the drawing, the receiver is in a second circuit inductively connected with that which contains the transmitter, and in that case, in the usual manner, the voice-currents of the circuit engaged in transmitting are inductively reproduced in the second circuit to operate the receiver.

WEATHER NEWS BY TELEPHONE.

Weather Prophet Dunn has completed arrangements for supplying inquirers with the very latest weather news in New York City by telephone. A special telephone has been put in his office to be devoted to that purpose. Hereafter anyone who desires to ask a special question about the weather may be reasonably sure of a prompt reply, which was often impossible when the general telephone was the only one available. Any subscriber in the telephone system who wishes to be notified of important weather changes and forecasts may receive such notice free of charge by sending his name to the Metropolitan Telephone and Telegraph Company. In this class of information will be included news of heavy storms, cold waves, warm waves, and snow storms.

Mr. Dunn said last week that the new arrangement was to meet a growing demand for the latest information on the part of business men, who have had to rely chiefly heretofore on the two regular daily forecasts.

"It is largely for the benefit of commerce," said Mr. Dunn, "that the Weather Bureau exists, and what we wish most to accomplish is to take every possible means to increase the practical utility of the service. This is one step in that direction. The time when the forecasts were mainly a subject of jest is past. They are accurate enough now to be of great value in preventing loss to many commercial interests. They will be made of greater value by this arrangement, which increases their accessibility."

Similar arrangements for telephonic reports will probably be made throughout the country, and have already been discussed in other cities. The Chief of the Weather Bureau has written to the forecast officials in all the principal cities to provide such accommodation.

THE STANDARD TELEPHONE COMPANY.

A representative of the Standard Telephone Company, a local branch of which is seeking franchises in this city, was asked yesterday for an explanation of assertions recently published (notably in The Electrical Engineer) to the effect that the Wisconsin stockholders of the Standard Company had demanded an accounting on the ground of their belief that for the money subscribed by them the company had nothing of practcial value to show. He said that it was highly improbable that the Wisconson State organization had brought any such suit, as General Clarkson is President of the company that includes Wisconsin in its district and two other Standard Directors are members of that Board. Relative to the suit that was threatened by the New Jersey Directors on the same ground, five members, he said, met General Clarkson, Mr. Nye and another director of the parent company, and, after a conference, at which patents were produced, entire harmony was restored.—*Phila. Ledger.*

THE PACIFIC CABLE CO.'S PLANS.

A meeting was held last week at the office of the Central and South American Telegraph Company, New York City, for the purpose of completing the organization of the Pacific Cable Company. This company will be independent of the Mexican and Central and South American telegraph companies in its organization, but they will have relations which will be mutually advantageous.

The proposed cable will connect San Francisco with the proposed American naval station at Pearl River Harbor, in the Sandwich Islands, Japan, China, Australia and India. It is understood that the contract relations between the Western Union Telegraph Company and the English Atlantic cables expressly provide that the Western Union Company is free to use a Pacific cable route with the countries named, but, aside from this fact, it is asserted, it will be in the interest of all the Atlantic cables to send their messages to the East via this Pacific cable, as it is estimated that more than 90 per cent. of the traffic is European. Thus the establishment of an American Pacific cable will attract to it a large traffic which is now diverted to other lines.

This American company is expected to become a serious rival to the English lines represented by Sir John Pender, and the proposed Canada and Australia cable now being considered by the English Government.

A committee on plan and scope was appointed, with Edmund L. Bayliss as chairman. James A. Scrymser was chairman of the meeting, and James R. Beard, secretary.

The Pacific Cable Company was incorporated on Dec. 10 with a capital of $100,000. The directors are Edmund L. Bayliss, H. L. Leroy, C. D. Wetmore, G. A. Mills, Montclair, N. J.; J. M. Robertson, and W. H. T. Hughes of New York, and F. H. Allen, Pelham Manor.

Kalamazoo, Mich.—The Oak Telephone Company, has been incorporated with a capital stock of $20,000 for the operation of a telephone line for commercial use in the limits of the village. The company have about fifty miles of wire up and sixty telephones in use. The officers are: C. J. Monroe, president; D. E. Harmon, treasurer; H. E. Dewer, secretary and manager.

HIGH PRICED TELEGRAPH PROPERTY.

The Western Union Company is occupying four inches of land in Broad street, for which it may be compelled to pay the largest price ever given for land in this city. The Commercial Cable Company, which is about to build a twenty-two story building adjoining that of the Western Union, has, it is said, discovered that its rival has encroached four inches upon its territory. The actual value of the land so occupied is, at a liberal valuation, about $16,000, but a much larger sum will undoubtedly be exacted, and it is rumored that the Western Union will offer $100,000. There was a meeting this afternoon between directors of the two companies to consider the disputed land question, but what conclusion was arrived at is not known.—*N. Y. Mail & Express.*

MISCELLANEOUS.

CURRENT ELECTRICAL SCIENCE.

In No. 10 of *Wiedemann's Annalen* F. Kohlrausch writes on several improvements in Wheatstone's bridge. He uses a long wire wound on a roller along a flat groove, the material of the roller being marble, or wood boiled in paraffin. To increase the accuracy of the readings resistances are introduced at each end of the wire, amounting to 4 5 times the resistance of the wire itself. When the inequality between the two resistances to be compared does not exceed 20 per cent., and the scale can be read to 1 in 10,000, the error of a determination does not exceed 1 in 25,000. A commutator with six blocks admits of putting in the additional resistances on one or both sides. In another paper E. Wiedemann and G. C. Schmidt continue their previous researches in their newly-explored field of Cathodic Luminescence. The most beautiful colors observed are the red of mixed magnesium and manganese sulphates, the yellow of cadmium sulphate, the green of calcium fluoride and manganese, the dark blue of quinine bisulphate, the violet of lead sulphate, and the brilliant white of zinc sulphate, or sulphide, and cadmium iodide. The "solid solutions," in Van't Hoff's sense, containing traces of manganese sulphate in combination with other substances, vary in hue with different solvents, but not with different concentrations. Luminescence ranges over all temperatures from — 80° C. to + 500° C., but the intensity of the glow, and the duration of the after-glow, is greatest at the lowest temperatures. The sulphates of iron, nickel and copper extinguish the luminescence, even in small quantities.—*London Electrician.*

ON THE MAGNETIC FIELD OF ANY CYLINDRICAL COIL OR PLANE CIRCUIT.

At the meeting of the London Physical Society on November 8th, Mr. W. H. Everett read a paper on the above subject.

The method of treatment is based on the formula for the force due to an element of current. A single integration applied to one component of this force gives for any point in the field due to a plane circuit the force perpendicular to its plane, and a double integration gives the longitudinal force at any point due to a cylindrical coil of any cross-section, the depth of winding being supposed inconsiderable. For coils in which the latter condition does not hold, an approximate solution can readily be found. The force parallel to the plane of a circuit and the transverse force due to a coil are investigated in a similar manner. The general results are of a very simple form, and admit of easy approximate calculation. Special formulæ are deduced for coils of rectangular cross-section, the general expressions being in this case integrable. Appended to the Paper are some numerical results giving the values of the forces at different points due to coils of various dimensions.

THE SWISS NATIONAL EXHIBITION.

The Swiss National Exposition, which begins at Geneva May 1 next, and terminates Oct. 15, bids fair to be very interesting. A full account of its scope is given by United States Consul Ridgley at Geneva in a report to the State Department, and he says that Swiss residents in America are invited to make exhibits. Theodore Turettini, mayor of Geneva, one of the most distinguished engineers in Europe, is president of the exposition.

The river Rhone supplies power which will be electrically transmitted six miles to the grounds. There will be a travelling footpath, operated by electricity, traversing the great machinery hall; horseless cabs driven by electricity, appliances for aerial navigation, and many other electrical appliances.

Prof. Pictet will display his inventions for producing intense cold, showing a temperature of 415 degrees below zero, and will exhibit the uses of this low temperature, such as in the purification of perfumes and chemicals, the cure of dyspepsia by a cold turkish bath process, disinfecting, and the production of an illuminating gas 30 times more powerful than ordinary coal gas.

THERMO-ELEMENTS FOR MEASURING RAPID VARIATIONS OF TEMPERATURE.

The well-known difficulty of obtaining instruments which will indicate rapid variations of temperature, has induced Mr. Paul Czermak, of Graz, to try thermo-elements with very fine wires for meteorological observations. These are better than thermometers with platinum bulbs, and much superior to glass-bulb thermometers, where rapid variations are to be measured. One of the instruments constructed consists of a thermo-couple of copper and constantane wire 0.1 mm. thick. The ends are soldered to two hollow copper cylinders drawn into a point at the ends, and mounted side by side on a wooden support. The cylinders contain water, and hold ordinary thermometers indicating the average temperature. This instrument, when used in circuit with a strongly-damped aperiodic galvanometer, showed variations amounting to 2° C. within five minutes on a clear frosty Tirolese morning. The stratification of the air in layers of different temperatures was less in the afternoon. The paper describing these results, in *Wiedemann's Annalen*, also gives an account of a "relative actinometer" consisting of two concentric copper cylinders. The interior one is empty, and across one end of it are placed three thermo-couples in parallel, protected from draughts by a plate of rock-salt mounted obliquely to the axis of the cylinders. This instrument indicates the slightest variations of the intensity of solar radiation, such as those produced by different thicknesses of a filmy cloud.

TIN FOIL GRATINGS AS ELECTRIC WAVE DETECTORS.

A NOTE on the tinfoil grating as a detector for electric waves, by T. Mizuno, appears in the *Journal* of the College of Science of Tokyo. The author has been repeating and extending Aschkinass' most interesting experiments on this subject. The gratings employed are formed by coating a flat wooden block with tinfoil, and then cutting on it a number of fine parallel slits with a sharp knife. Two gratings have been used, one having a resistance of 130 ohms, and the other of 232 ohms. The wave-length of the electric radiation employed was about 60 cm. On exposure of these gratings to the electric radiation, the resistance fell in some cases as much as 11 ohms and 42 ohms respectively. Gentle tapping was sufficient to cause the resistance to increase to almost its former value. The experiments indicate that the angle which the plane of polarization of the radiation makes with the strips of the grating influences the results to a certain extent, a greater decrease of resistance taking place when the strips are perpendicular to the plane in which the primary oscillations take place. The author has made some experiments with a view of determining whether the change in resistance is due to a molecular change in the tinfoil, or whether the change is a mechanical one. He has constructed gratings in which the spaces between the strips were much larger than in the above gratings. With this grating, however, no indication of a decrease of resistance under the action of electric radiation was observable. Gratings formed of fine german-silver wire and fine iron wire, also, showed no effect. The author concludes that the change is a mechanical one, and suggests that it may be due to small jagged points on the neighboring strips coming into contact under the influence of the electric waves.

EDUCATIONAL.

UNIVERSITY OF WASHINGTON, WASH.

The University of Washington at Tacoma, is putting in an isolated electric light plant. The power is supplied by a Ball engine.

PERSONAL.

MR. CHARLES M. SPRAGUE, assistant treasurer of the Windsor Print Works, of North Adams, Mass., has resigned that position in order to join the Sprague Electric Elevator Co. of New York City.

MR. LEWIS I. FLETCHER has resigned his position as manager of the Lowell Electric Light Co., and was presented with a diamond ring by the employees of the company, with which he had been associated six years. He becomes manager of the H. M. Bates Machine Co. of Boston.

MR. FRANCIS R. UPTON, late general manager of the Incandescent Lamp Department of the General Electric Co. has severed his connection with the company and has joined the forces of the National Tube Co., of McKeesport, Pa., where he will hold an important position in the general manager's office. It is with extreme regret that we note Mr. Upton's withdrawal from the electrical field. He carries with him the best wishes of a host of friends for his abundant prosperity in a new career.

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CONTENTS.

THE ELEVATED RAILROAD PROBLEM.

INQUIRY upon the subject shows that a recent rumor of no little importance and significance is broadly true. The report is to the effect that Mr. Frank J. Sprague intends at an early date to take up the problem of electric traction as applied to such systems as the New York Elevated roads; and its accuracy may be inferred from the official incorporation under the laws of New Jersey, within the last day or two, of the new Sprague Electric Railway Company, with a capital stock of $1,000,000. We have considered the matter of sufficient interest to the electrical community to investigate it pretty thoroughly, and while not in possession of all the details we would like, we are satisfied that the coming year will witness some remarkable work of the nature indicated. Mr. Sprague admits that it is his specific purpose to deal with the elevated and suburban railroad problem, and appears to be quite satisfied that he has in his grasp the solution of all the serious difficulties peculiar to it.

They who are in any wise familiar with the situation in New York know that it has literally reached a crisis. The public is not only gravely displeased with the service it receives from the Elevated Roads, but has deserted them to such an extent that while the surface roads have gained very heavily during the last year or two, the Elevated system has lost millions of passengers. Moreover the quality of the service is becoming more and more distasteful to a community whose ideas of the seemly and proper are more finely educated every year. In other words, the present methods of propelling, lighting and heating the cars, as well as the physical tax of stair climbing, are universally felt to be behind the age and far short of the resources of modern engineering. All this the management virtually admits. Mr. Gould conceded as much on the witness stand the other day. Yet in view of the magnitude of the questions and interests at stake, neither he nor Col. Hain has been willing to assume the responsibility of a new departure.

At this opportune juncture, Mr. Sprague comes forward to deal with the special problem in the same radical way he has dealt with others; and we all know that when he says he is going to settle anything of this nature he settles it. Mr. Sprague is emphatically not only a distinguished inventor but a successful engineer. There are at least three fields upon which his record is written so deeply it can never be effaced, namely, stationary motor work, the trolley railroad industry, and the electric elevator. In each department, the beginning of real industrial advance may, without injustice to other men, be traced to some definite achievement of Mr. Sprague, who has in high degree the quality of persistence as well as of leadership, and who, like General Grant, simply hammers at the obstacle until it has to succumb. If, therefore, Mr. Sprague announces that the time is at hand when he will find leisure and opportunity for the disposition in a satisfactory way of this latest problem, we confess our pleasure that such is the case, as it means an immediate bringing of the goal within view.

One is naturally curious to know upon what lines Mr. Sprague is likely to make his attack. His opinions on trunk line operation, as set forth in his inaugural address as President of the American Institute of Electrical Engineers in 1892, are well known; and as regards urban service, unless he has changed his mind, and now entertains views different from those which he expressed, as we well remember, before the Boston Society of Arts, and other bodies, at least ten years ago,—he believes principally in the unit motor car as opposed to the train locomotive. The Elevated Railroad problem is certainly not more difficult or complicated than that which Mr. Sprague has dealt with in high speed electric elevator service; but, of course,

has some sharply distinct questions to be settled that are not found in any other class or method of travel. It would seem, however, that with unit cars each capable of its own propulsion with a full load, yet adapted also for linking together in larger units for handling traffic in bulk and at high speeds, New York would get at once a service that it certainly does not enjoy now; while the resort to electricity would dispose at one sweep of all the details of lighting, heating, blocking and elevating, in addition to way train operating and high speed express service.

Mr. Sprague is not now undertaking a subject with which he is unfamiliar. Except the officials of the road, few know as well as he its engineering nature and physical condition. He has, moreover, already tried electric motors on one branch of the road with notable results, and since that time the art has made tremendous strides so that what were exasperating difficulties then are utterly unknown now. Besides that, he takes up this new problem in robust health, with maturer years and a ripened experience, and the same energy which has stood him in good stead in his past work. He has also at his command the resources of more than one large electric manufacturing establishment, any of which would, to our certain knowledge, welcome the chance to equip such a system as the Elevated, under conditions assuring credit to the apparatus and another great triumph for electricity.

"KEEP THE LIGHTS GOING, ANYHOW."

One of the most interesting and important suits, in regard to the practical side of central station work, was that decided in Brooklyn last week, in which the issue was sharply drawn between bad design and material on one hand and bad management and use on the other. The case, which is very thoroughly summarized in our Legal Notes on another page, arose out of the troubles experienced by the Philadelphia Edison Company with its boilers four or five years ago, soon after starting its plant. The accidents were serious; in one instance fatal, and were none the less mysterious because the boilers were of long established reputation while the management of the local company had been entrusted to engineering talent of high rank. But the verdict given by a judge and jury in a U. S. Court in favor of the boiler manufacturers, and the remarkable evidence brought forward as to misuse of the boilers, settle and explain the whole matter in a way that is full of valuable lessons for those engaged in central station work.

The general and even brilliant success of the Philadelphia Edison Co. as a commercial undertaking and dividend earner is well known, but it is obvious that to run serious risks for the sake of continuity of operation will sometimes go far to mar even the best record. It is simply amazing to read in this litigation, of boilers being driven so far above their rated capacity; of such unflinching resort to extreme forced draft; of the use of such extraordinarily impure feed water, and of the employment of chemical purgatives in such quantity and degree. We confess our admiration of the spirit which says that the lights must be kept going anyhow; but we cannot admire the disposition, when something at last gives way under the violent strain, to blame this natural result upon the abused apparatus. It is a fundamental principle for every central station manager to bear in mind, that an interruption in his service counts more against him than months and years of steady delivery of current will win praise for him; but surely there are other and better ways of taking care of an undue or abnormal load than racking all the appliances to the point of destruction. For some time past we have felt it our duty to urge the use of storage battery adjuncts as a reserve and as a safety factor; and we do not hesitate now to assert with equal vigor our belief that in any plant it is the first requirement of a manager desiring to give continuous service that it shall treat its engines, boilers and dynamos with at least ordinary prudence. By timely coincidence, we are able to present this week, the terse and simple review by Prof. F. B. Crocker, of the subject of feed water and its purification, in which with wonted clearness, he sums up the conditions to be studied, and shows that, after all, the elementary facts are as firmly grasped and clearly understood by electrical engineers as by those who are specifically steam engineers.

In the present instance, the boiler manufacturers have undergone no common ordeal, and they are fairly entitled to full recognition of the fact that they come out of it with, if anything, enhanced credit and reputation.

THE UNDERRUNNING TROLLEY DECISION.

The electrical arts have unfortunately been prolific of extended litigation in the United States, beginning with the celebrated case of Morse vs. O'Reilly, but we doubt whether, considering the widespread use of the invention and the amount of invested capital involved in the plants in which the invention is employed, a more important case has been decided than that in regard to which we printed last week Judge Townsend's decision upholding the validity of the Van Depoele underrunning trolley contact patent. Judge Townsend holds that Van Depoele's adoption of the underrunning trolley for the purpose of electric railroading was in every way invention in the broad sense of the word, and that the anticipations cited, showing the use of a similar device for other purposes, do not constitute a bar to his claims as the original inventor. The case will, of course, be appealed by the Westinghouse Company, but in the meantime it might be worth while to look upon the ultimate effect which a final sustaining of the patent may have upon the railroad field. For those not authorized to use the underrunning contact trolley, in case the decision should be appealed, recourse, to be sure, may be had to the old overrunning trolley, but we doubt whether the annoyances which led to the abandonment of this type and to the adoption by Van Depoele of the underrunning contact will ever be again seriously faced. One way out of the difficulty may possibly be found in the use of side contact trolleys, one type of which, due to Mr. George Westinghouse, Jr., was recently illustrated in our columns. We might also suggest that the whole question may be solved in city work by the adoption of the conduit railway.

The decision stands in bold contrast to many that have preceded it in the electrical field in which important patents have been invalidated, and to that extent will be hailed with pleasure by many who have begun to look with deep distrust on our patent system, and who have come to regard it merely as a device for the Government to extract the hard earned dollars from the pockets of the inventor, without giving him an equivalent. The course of the General Electric Company, the owners of the Van Depoele patent, in their dealings with companies not supplied with their railroad apparatus will be watched with great interest. Thus far they have given no indication of the policy which they propose to pursue in the matter. We hope, however, that they will not pursue the course, so ruinous to themselves, adopted with regard to the incandescent lamp, but that a spirit of liberality will mark their dealings with those who may be finally adjudged to be infringers of the Van Depoele patent.

THE UNDERWRITERS' RULES.

We present in this issue a very full report of the work of the Underwriters' National Electric Association and of the proceedings of its Electrical Committee last week. The report will be found very interesting, and it is evident that efforts are being made to improve the rules which become every year more binding and authoritative in regard to electric wiring of all classes.

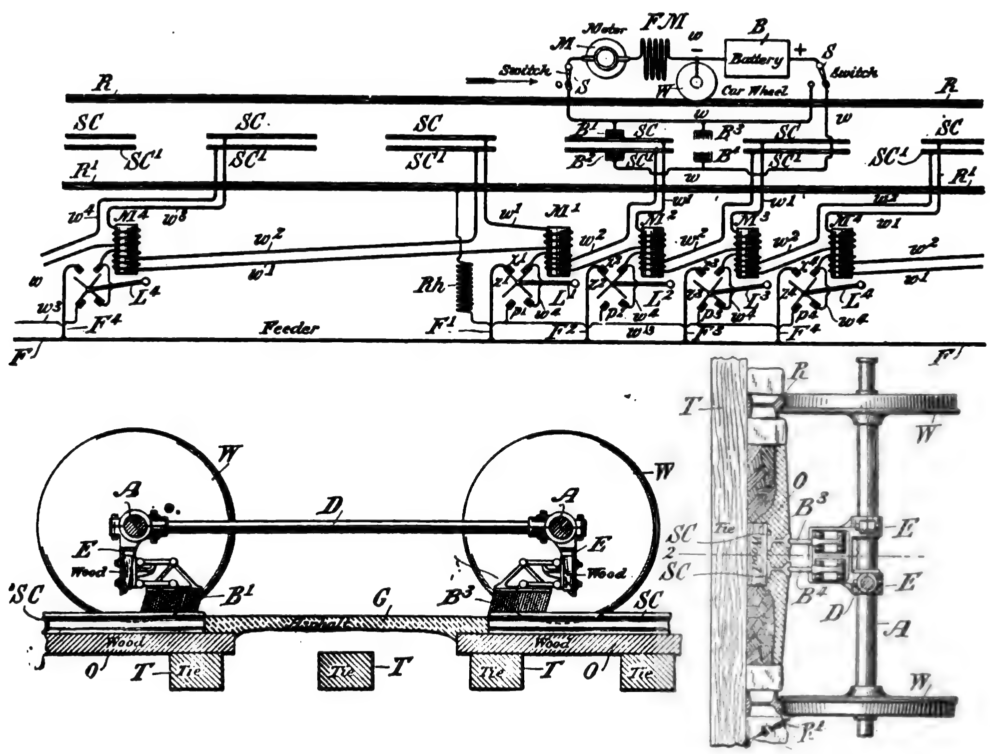
ELECTRIC TRANSPORTATION DEPARTMENT.

THE IMPROVED JOHNSON-LUNDELL CONDUIT RAILWAY SYSTEM.

Since the publication of the description of the Johnson-Lundell conduit railway system in our issue of May 9, 1894, this system has been steadily worked on and improved by the inventors. The experience gained in the experimental track in this city has resulted in evolving a system the details of which have been recently patented by Mr. R. Lundell, and which can be constructed for less cost and which still further minimized the liability of leaving any sectional trolley conductor connected to the current feeder after a car has passed over it; together with a number of other advantages. It will be recalled that in the Johnson-Lundell system the current is automatically switched into the trolley section immediately under the car and likewise switched out after the car has passed off the section.

Referring to the accompanying illustrations, Figs. 1, 2 and 3, it will be seen that each sectional trolley-conductor S C is connected directly to the coils of two adjacent electromagnets in series and that the first and last magnet in each group are connected similarly and also that each sectional trolley conductor S C' is connected directly to one coil of the magnet which controls the circuits for that particular sectional conductor, the arrangement being such that as the brushes B' B² and B³ B⁴ bridge the spaces between the succeeding pairs of conductors the switches will be actuated in succession and little or no arcing occur at the switching contacts x', x^2, x^3, z^4 and p', p^2, p^3, and p^4, which contacts are all of carbon.

The operation of the system will be understood by referring to Fig. 1 in which a car is supposed to be passing from left to right, the propelling-current passing from feeder F by sub-feeder F', fixed carbon contacts x', movable contact-springs z' carried by armature lever L', lower coil of electromagnet M', upper coil of electromagnet M² (energizing both of the magnets and maintaining their armatures in their upper or active positions as shown), conductor w' to sectional trolley conductor S C, contacting brush B', conductor w, rear switch S, motor M, F M, wheel W through rail R to earth and to the other pole of the power-house generator. A multiple or branch circuit is simultaneously closed as follows: From the central coil of magnet M' by conductor w^2, sectional trolley-conductor S C' contact-brush or trolley B², conductor w to front switch S through the storage battery B to wheel W and to earth as before, thereby supplying battery with a charging current. As the armature levers L' and L², are drawn forward the normally-closed high-resistance earth or safety circuits are broken and as the car passes on they are successively closed. At the same time the movable contact-springs z^2 carried by armature-lever L² were put into contact with the fixed carbon contacts x^2 and the next pair of sectional trolley conductors S C and S C' in advance connected in circuit and adapted to convey current as soon as the brushes B³ and B⁴ shall pass upon them. Should the circuit be actually ruptured at any time by opening the rear operating-switch S, or as would be the case at a crossing or at some point where the sectional conductors were discontinued, then the car could of course be propelled directly by the storage-battery B by simply changing the front switch to its rear position so that the battery-current will all flow directly through the motor. On arriving at a section of the roadway provided with sectional conductors S C S C' the switches S and S would be again placed as shown, and the battery-current would actuate the first switch-magnet put in circuit and the car proceed as before under control of the power-house-generator current.



Figs. 1, 2 and 3.—Improved Johnson-Lundell Conduit Railway System.

The contacting brushes, B', B², B³ and B⁴ are made of metallic strips secured to brush-heads which in turn are carried by links pivoted to supports secured through wooden blocks by bolts and oblong bolt-holes to the arms E E; these arms have at their lower ends each a rest or support, which limits the downward movement of the brush-sustaining links. It is the function of these rests or supports to carry the brushes bodily above and out of contact with the asphalt when they leave the ends of the sectional trolley conductors or when riding over the rails of crossing tramways, which it will be noted will occur as the upper surfaces of the conductors S C and S C' are noticeably higher than the level of the rails. With such an arrangement, therefore, the construction of especial crossing apparatus is avoided and a material cheapening in the cost of the apparatus effected as well as a saving in the wear of the brushes.

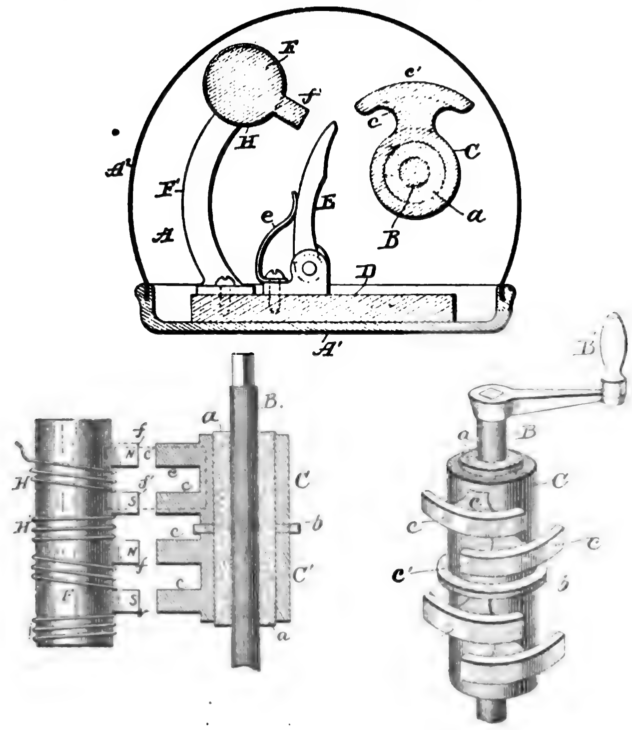
A CLEVELAND CLUB CAR.

A novel car will probably be running next spring on the Cleveland, Painesville and Eastern electric line. It will be known as a club car and will be for the exclusive use of the individuals and their families who secure an interest in the car. It will be luxuriously furnished and each seat will be rented for the season.

PROF. SHORT'S NON-ARCING CAR CONTROLLER.

The wear caused by arcing at the switch contacts of car controllers has in the past necessitated frequent replacement of the contacts besides causing much annoyance. To obviate this difficulty Prof. Sidney H. Short has devised a simple method of providing each controller contact with a magnetic blow out.

The device for that purpose is shown in the accompanying illustrations, Figs. 1 and 2. Upon the shaft are mounted the sleeves C C′, which are insulated from the shaft by the insulating sleeve *a* and are insulated from each other by the interposed insulating-washers *b*. The sleeves C C′, are made of cast-iron and have



Figs. 1 and 2.—Short's Non-Arcing Car Controller.

cast integral with them the segmental contacts *c*, the peripheral surfaces *c′* of which are finished smooth and true to afford good contact-surfaces. Upon the wooden strip D are mounted the contact-fingers E, the free ends of which are kept in engagement with the rotary contacts C by means of the springs *e*. The core F is constructed with a series of pole-pieces *f f′*, which are so spaced that each one of these pole-pieces will be located opposite and in close proximity to one of the segmental contacts carried by the controller-shaft. Around core F are wound a series of coils H H′, each of which is composed of a few turns of comparatively low-resistance conductor which is included in the main circuit of the motor. As will be observed, each adjacent coil is wound in an opposite direction, whereby an opposite polarity is given the adjacent pole-pieces, as is indicated by the letters N S. When current flows through the coils H H′, the core is magnetized, with the result that a series of complete magnetic circuits are formed, each complete circuit including two adjacent poles N and S and the two segmental contacts on the adjacent insulated sleeve, as is indicated in dotted lines. There is thus produced a magnetic field in the air-gap between each one of the rotary contacts and one of the poles of the electromagnet F. When the controller-shaft is rotated so as to move the segmental contacts carried thereby out of contact with the contact-fingers and thereby break the circuit through which a current is flowing, an arc would form between the two contacts thus separated were it not for the presence of the magnetic field, which envelops the point of rupture and serves to disrupt and suppress any such arcing.

Owing to the fact that the rotary contacts serve in effect as armatures to the series of electromagnets and form part of the complete magnetic circuits, the lines of force are concentrated within the comparatively narrow air-gaps within which the circuits are broken, and hence small magnet-cores and a few turns of conductor of low resistance are ample to maintain a series of magnetic fields of sufficient strength to prevent arcing between any of the series of contacts.

Chicago Grade Crossings.—People in Chicago are usually supposed to be in an awful hurry, but recent investigation shows that they lose a lot of time at the grade crossings. Out of eight hours a day, the Wentworth Avenue line on the South Side, loses five hours and fifty-three minutes because the gates are closed.

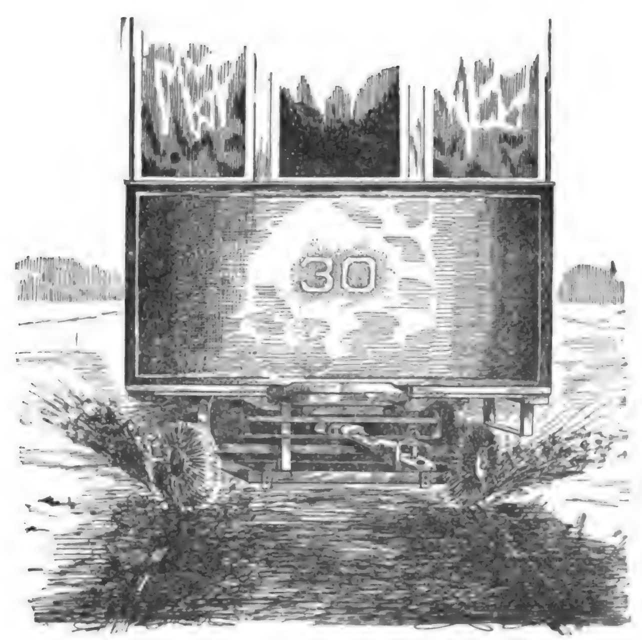
THE HICKLEY STREET CAR TRACK CLEANER.

The Hickley Launch and Electrical Mfg. Co., with the advent of weather unpropitious for electric launches, has turned its attention to other devices interesting to electrical people, and the first of these post-Summer products is a device for clearing tracks of street railways from accumulations of dust or, in winter time, snow and ice. The principle is that each street car shall be its own track cleaner, and the means thereto as provided by the company seem at once efficacious and simple. The illustration shows the front of car No. 30 of the Sea Shore line at Asbury Park, N. J., on which car tests have been made. Two circular brushes, suspended from beneath the car platform are laid at an angle to the direction of track, as will be seen by the illustration, and the motion of the car drives the brushes which are revolved by friction of the rails. The angle at which these brushes are placed has been a matter of study and experiment, with the result as shown. The brushes are made of either rattan, bass or flat galvanized spring steel, the last named of course giving the best service, because of cutting snow or ice and at the same time resisting better the elements of wear.

These brushes are easily applied to any make of car. They are mounted on a triangular frame, the apex of which is fastened to the car body by a hinge, the brushes being placed on the outer edges of the triangle. By a simple lever movement the brushes are lowered to or raised from the track. The lever is placed at the dashboard, or in the case of vestibuled cars behind the motorman. It will be observed that the ease of operation results in applying at the first fall of snow the remedy for keeping the tracks clean; and as the intention is to have each car of a road supplied with these brushes, the passenger cars themselves are sufficient to keep the road entirely clean without resorting to expensive sweepers and plows.

The sending over the road of a nose plow results in leaving on the tracks what is technically known as a "skin," for the reason that no plow can work satisfactorily on the edge of the track. A plow thus adjusted is apt to catch at the joints of the rails, or in switches, causing some damage, hence the raising of the knife of the plow and resultant skin of snow. This snow hardening turns into ice and of course interferes with the running of the car. In the case of electric roads, the resistance to the current is so high as sometimes to stop the cars. The difficulties of the situation are well known to those who have the handling of cars on roads liable to be attacked by heavy snow storms or to be overwhelmed by heavy mud and slush.

This condition of affairs is met by the Hickley Company, who, in addition to their brushes are furnishing steel nose plows, a foot



Hickley Street Car Track Cleaner.

deep, wchih run just in front of the brushes, taking off snow to the depth of 1½ or 2 inches, the brushes taking care of the rest. These plows are as easily operated as the brushes, working from a lever on the car platform.

The fixed track brooms now employed are 6 inches long and 2 inches wide, with bristles 4 inches in length, while the Hickley brushes have a diameter of from 18 inches to 2 feet, depending on the height of the car, with a width of 6 inches and 8 inches of bristles. It will be noticed that the wearing surface of the latter is greatly in excess of the former.

Canadian (No. 50,514) and U. S. patents (No. 551,209) have recently been issued covering this brush which will be on the market in a very short time. Already, some orders for them have been filled, the simplicity and effectiveness of the brush being so apparent as to cause a demand for them. The Hickley Company is located at Asbury Park, N. J., where experiments have been conducted for some little time.

GERMAN TROLLEY SPAN WIRE WALL ROSETTES.

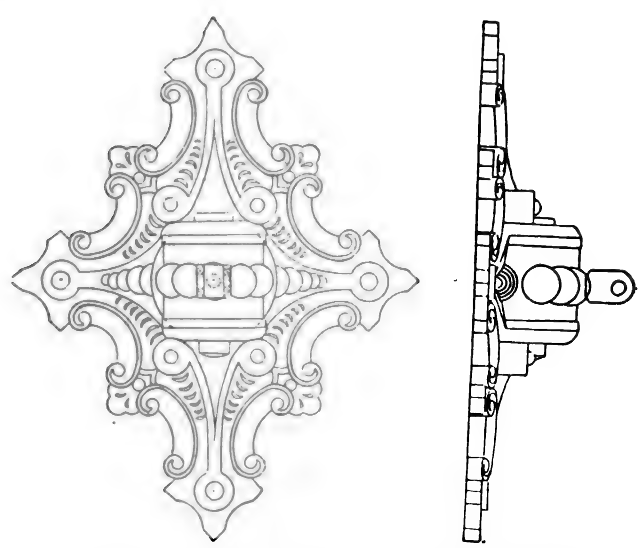
BY LOUIS J. MAGEE.

MR. E. J. WESSELS, upon the occasion of his recent visit here, told me that THE ELECTRICAL ENGINEER was interested in our railway construction work; and I have pleasure in sending, therefore, photograph and drawing of our standard rosette for cross-

GERMAN TROLLEY SPAN WIRE WALL ROSETTE.

suspension construction. We have from time to time prepared other designs to suit the demands of the architects of especially fine buildings on which rosettes were to be placed.

Some years ago, when we were beginning with street railway work in Germany, one of our engineers was very much surprised at being called upon to design a Gothic rosette for a bank, instead



GERMAN TROLLEY SPAN WIRE WALL ROSETTE.

of the Renaissance rosette which we had proposed to put on the walls. In some of the cities of Germany and Belgium where we have installed roads we have succeeded in using a large proportion of rosettes instead of poles. In each case the local tramway company signs a printed contract with the owner of the house upon which a rosette is placed. We have about 3,500 of these rosettes in use.

The castings are thoroughly annealed. The rosette is provided with holes for three suspension eyes. Besides the span wire, anchorages are also made from the rosettes. For the purpose of obviating the disturbance of vibration being transmitted to the house from the wires, the rosette is provided with a thick cylinder of india rubber.

Of course, if permission for placing a rosette on a house is refused, we fall back upon the general franchise and set a steel pole in front of the house.

BERLIN, GERMANY.

THE CAR PLATFORM NUISANCE.

The highest state court of New York recently rendered a decision which will attract very general attention. The court decided that a passenger thrown from the platform of a car can recover damages for the injuries he sustains. The court refers to the practice of street car companies permiting persons to ride on platforms of their cars and holds that this practice precluded the company from claiming exemption from damages for resulting injuries. The decision applies, of course, only to New York, but it will serve to call attention to one of the great annoyances of street car travel which comes from permitting passengers to ride on platforms. Many persons prefer to ride on platforms when there are plenty of seats inside. It is probable that the New York decision will have a tendency to abate this nuisance. If street car companies are to be held responsible for damages to platform passengers in spite of their rules and regulations they will be apt to enforce those rules more rigidly.—*Atlanta Journal.*

PERFORMANCE OF B. & O. ELECTRIC LOCOMOTIVE, NO 2.

Electric locomotive No. 2, the latest electric giant put on the Belt Railroad, added new laurels a few days ago to the noteworthy performances of locomotive No. 1.

No. 2 hauled 28 loaded cars, two "dead" engines, and a caboose, a total weight of about 1,400 tons, through the tunnel at the rate of 28 miles an hour. The train entered the tunnel at a speed of 20 miles an hour. A stop was made in the tunnel, and with all drawbars stretched the start was again made without a slip of the wheel. In doing this and accelerating the train up to the speed of 28 miles an hour a drawbar pull of 58,680 pounds was exerted. With this tremendous strain the engineers say the least jerk would have snapped a coupling pin and broken the train apart. From one of the locomotives on the rear end of the train, where a jerky motion would be felt the greatest, an entire absence of such a jar was noted. During the work a current of 4,100 amperes at a pressure of 600 volts was measured. The test is regarded as the severest yet attempted by such a locomotive.

On the locomotive during the test were: E. W. Rice, Jr., of the General Electric Company; W. B. Potter, chief engineer of the company, and A. K. Baylor, of the railway department of the company, all of Schenectady, N. Y. Supervising electrical engineer Parker and assistant engineer Shepard were also present.

No. 3, which will complete the number of locomotives for the Belt Line service, is now approaching completion at Schenectady and will be taken to Baltimore about January 1.

USES OF THE PLASTIC RAIL BOND.

BY HAROLD P. BROWN.

THE Cleveland Electric Railway Company have recently been inspecting and tightening their copper bonds on the Cedar Avenue line near their large power house. Here there were two sets of bonds; one of No. 0000 around the chair to the web of rail, and another of four No. 0 wires in a casting rivetted to the tram near end of each rail. Even after the tightening, the loss at each joint during heavy load ran from 0.08 to 0.85 volt per joint. A new form of plastic rail bond was then applied by drilling a horizontal hole through web of rail and sides of chair against same on each side of the joint. The steel was amalgamated by the Edison process and the hole partly filled with the plastic alloy, which thus made contact between rails and chairs supporting same. Then a tapering soft iron plug was driven in from each side and held in place by a stove bolt through central holes in plugs. After completing this work the drop was but 0.015 volt per joint at the time of heaviest load.

Another very promising field for the use of the plastic bond material has been developed by the Buffalo Railway Company. Measurements were made of the drop between the negative brushes of one of their large dynamos and the rail bus-bar, and between the positive brushes and the switch board; these showed a drop which was larger than it should be with the amount of copper in circuit, with a load of 1,200 amperes. Every unsoldered contact in that circuit was then amalgamated and covered with a layer of the plastic bond material; on remeasuring the drop with the same load it was found that nearly three electrical horse power had been saved, in spite of the fact that the conductors throughout had a section of one and a half square inches.

Mr. Dunning, the Master Mechanic of the road, and Mr. Henning, the Chief Engineer, have therefore decided to apply the plastic bond material on all unsoldered copper contacts on dynamos, switches, bus-bars and instruments in the power house, on all unsoldered connections on motor cars and on all line switches and cut-outs.

Legal Notes.

A DECISION IN FAVOR OF THE PROPER CARE OF BOILERS IN CENTRAL STATIONS.

Philadelphia Edison Electric Light Co. vs. Abendroth and Root Mfg. Co.

On the nineteenth of November last a suit was begun by the Philadelphia Edison Electric Light Company of Philadelphia, against the Abendroth & Root Mfg. Co., of New York City, to recover $34,000.00. A countersuit was put in by the Abendroth & Root Mfg. Co., against the Philadelphia Edison Electric Light Co., for $6,830.99. This suit was tried in the United States Court in Brooklyn, before Judge Wheeler and a jury, and a verdict has now been rendered in favor of the Abendroth & Root Mfg. Co., for the amount of the countersuit.

The Abendroth & Root Mfg. Co., are the manufacturers of the well-known Root Water Tube Boiler, and between the years 1889 and 1891 they furnished the Philadelphia Edison Electric Light Co., with about 3,500 horse power of boilers, these boilers being supplied on four different contracts, each of which followed the other at short intervals.

Soon after these boilers were erected and put in operation in the Philadelphia Edison plant, a series of troubles followed, which finally culminated in a fatal accident. This brought the matter into the Coroner's Court in Philadelphia, where, after a careful investigation by a jury of experts, a verdict was rendered acquitting the Abendroth & Root Mfg. Co., and holding the Philadelphia Edison Electric Light Co. responsible.

The troubles above mentioned were due, as claimed by the Philadelphia Edison Electric Light Co., to bad workmanship, bad material and faulty design, and also due to the contractors failing to comply with all the articles agreed upon in their contract, and on these grounds they brought the suit just closed, in which they sought to recover $34,000.00, which they claimed they had spent in remedying the so-called defects.

The Abendroth & Root Mfg. Co., claimed that the plaintiffs had not paid them all that was due on their orders for boilers, and also for additional material furnished to them, and on these grounds they brought the countersuit mentioned above.

The Abendroth & Root Mfg. Co. succeeded in the first place in establishing the fact that they had lived up to every article of their agreement and had even done more than they agreed to do.

In the second place they succeeded in establishing the fact that they had used the best material obtainable in the market. In this connection it is interesting to note that the greatest number of breaks occurring in these Edison boilers were reported to be in the item of bolts; and as it is a natural conclusion that the greatest breakage will occur at the weakest point, it was necessary to establish by evidence the fact that these bolts were equal, if not superior, to anything to be found in the market. When these bolts broke, in almost every instance a curious phenomenon occurred. At the point of fracture, the metal, instead of being contracted to a smaller area than that of the bolt itself, retained the original size and area, showing no contraction whatever, but breaking sharply and squarely in a similar manner to a pipe-stem. This caused the question to be raised as to whether crystallization had occurred, and to determine this point, many of these bolts were taken to a steam hammer and flattened out cold to less than ¼ of an inch in thickness. In every instance the flattening was done without the slightest show of fracture running up into the body of the bolt, whereas if crystallization had taken place at the point of rupture the metal would necessarily show brittleness and breakage similar to the action of a piece of cast iron similarly treated. Another test applied to many of these bolts was to bend them double when cold so that the two ends met, and this also proved the excellence of the quality of the bolts. In order to show that no effort had been spared to improve the quality of the material used, the Abendroth & Root Mfg. Co. had other bolts made of the best rivet iron, substituted in the place of the original ones, but all such bolts were fractured in identically the same manner, and a still further trial was made with steel bolts, which were affected with the same results. In order to make this breaking point test still stronger, ¾" bolts were substituted for the ⅝" bolts, but with no better results. Beyond this, the shape of the head, and also the shape of the lug which received the head of the bolts, were changed in every conceivable way, but all to no avail, as the fracture of bolts continued in this almost unaccountable manner, whereas fracture in the other parts of the boiler was very infrequent, indeed. It follows that no better evidence could be furnished or was needed that good material was used throughout.

In the third place, to answer the allegation of bad workmanship, the Abendroth & Root Mfg. Co., who have always been very jealous of their reputation, showed by means of photographs the tools which they now use in the manufacture of their boilers, and they proved that these same tools had been used in manufacturing all of the boilers supplied to the Philadelphia Edison Co. As these tools are made to produce interchangeable parts, with cutters and other working details fixed immovably in the same position and adjusted to such positions by sets of templets carefully standardized, and further as the positions of the metal parts of the boilers were fixed from working points produced in the casting, it was found impossible for the plaintiff to show that such workmanship could be other than that produced in the many boilers manufactured by the Abendroth & Root Mfg. Co. Moreover, as such trouble as was experienced in the Philadelphia Edison Station has never been known in other plants, it stood to reason that with workmanship and materials the same, all the troubles at the Edison Station must have been due to local conditions existing in the plant itself. This same argument bore also on their fourth claim of bad design.

In the fifth place, the Abendroth & Root Mfg. Co. set themselves to turn the tables, and succeeded in proving that the accidents were due entirely to the unreasonable handling of the boilers by the Edison Co., with the object of forcing these boilers far beyond their rated capacity, sometimes exceeding this rating by as much as 100 per cent. and over. They also showed that the Edison Co. employed unskilled labor, and that these employees had instructions to keep steam up to the required pressure irrespective of any demands that might be made on the boilers, and that the whole idea was to keep the lights going which the Edison Co., had contracted to supply, without regard to the personal safety of the attendants or capacity of the boilers.

One of the very important matters brought to light in this case, and acknowledged by the Edison Co., was the use of extremely bad feed-water. It seems that the Edison Co., sunk a well beneath their station, and this was the only water they used to supply their plant. This water, as was shown by the analysis presented during the trial, contained not a small amount of sewage, and ran thirty-four grains of impurities to the U. S. gallon, almost eight per cent. of these impurities being proved to be sulphate of lime; while salt existed in appreciable quantities, and also a number of nitrates and ammoniacal salts. This water was what might be called the surface drainage of the City of Philadelphia, and as the city has unfortunately, a very poor sewerage system, this drainage amounts to what might be regarded as sewer water which had undergone a certain amount of filtration in the earth down to the impervious strata along which it ran and finally collected in this well. In order to counteract the bad effects from this water, no small amount of chemicals was used. These were changed at times, and finally the Edison Co. seemed to settle down on the use of cutch, or what is more properly known in chemistry as catechu, which contains a considerable quantity of tannic acid. In the storage tank located above the boilers large quantities of caustic soda were also put in the water, making so strong a solution that water dripping from it would take the hair off the horses that passed beneath it, also inflicting serious burns upon the workmen who were so unfortunate as to catch a sprinkle. The result of the use of this bad feed water was naturally shown in the collection of a large amount of scale in the tubes, varying in thickness from $\frac{1}{16}$ of an inch to one inch, and thereby closing down very materially the area of the tube opening. The chemicals used attacked the metal parts of the boiler and oozed through the joints thus attacked so as to form incrustations, which had at times almost entirely covered the bolts and bends. This incrustation proved so hard that the workmen were obliged to use a hammer and chisel to remove it. This state of affairs caused a rigidity of parts which were designed to be flexible, and it also caused the unnecessary burning out of many of the tubes.

Another very important point established by the evidence was that an excessive forced draft was used in order to drive the boilers to the unreasonable extent to which they were used, and evidence showed that this draft was sufficient at times to support a column of water from three to four inches in height.

Several well-known experts appeared in this case and accounted for the various troubles above enumerated. One of the most interesting points developed was the production of water hammer in the tubes of these boilers, which was explained in the following manner: It is a well known fact that every pipe or tube has a definite capacity of discharge, and when this capacity is reached no more water or steam can be delivered through an opening of such an area; so that in case a larger discharge is required, a larger tube must be used. In driving these boilers to such an excessive extent, in the course of natural circulation the water and steam passed up along the inclined tubes to the front headers and there advanced upward into the overhead steam and water drums from which the steam was delivered to the piping system. When the circulation reached a point equal to the capacity of the tube, of course no more steam or water could be discharged from that upper end of the tube, but as the heat still continued to be applied around the tube, more steam was generated, and of course the pressure of this steam in the tube forced the steam and water back down the tube until it reached the rear header and here the steam suddenly had a chance to escape upward by the course of the rear headers to the overhead steam and water drums; and the colder feed and circulating water trying to enter the lower end of the tubes from these same rear headers came in contact with the steam thus seeking passage of escape. The result was a sudden condensing of the steam which was followed by a rush of water

into the vacuum at an exceedingly high velocity, and this water rushed along the tube at about this same velocity until it reached a bend at the end of the tubes. The result was a very sudden and powerful blow there, practically like that of a cannon ball, which caused the bolts to rupture in the manner above described, breaking them, in fact, so rapidly that a flow of the metal composing them at the point of rupture was impossible.

This flow necessary would take a certain amount of time. The consequences of this sudden blow was exhibited in the breakage of these bolts without contraction of area at the point of rupture. It was remarked during the course of the trial that it was fortunate that these boilers were composed of small headers covered by small castings known as connecting bends, and that thus the damage done affected merely these small castings, producing there local results instead of rupturing large castings, which would, of course, be attended by far more serious ruptures. Glass models were shown in court which illustrated beautifully the theory thus presented, and in such a manner as to carry conviction to the minds of the Court that this was the true theory of the disastrous occurrences. Other glass models illustrated the irresistible power of the water hammer, the force of which was sufficient to break the tubes, which held the water surrounded by a vacuum.

The counsel for the Philadelphia Edison Co., were Tracy, Platt & Boardman, and the counsel for the Abendroth & Root Mfg. Co., were Benedict & Benedict and Witter & Kenyon, of New York. The plaintiff brought in as an expert, Prof. Spangler, of Philadelphia, while the defendant brought in as experts Dr. C. E. Emery, of New York, and Prof. R. C. Carpenter, of Sibley College, Cornell University, Ithaca. Prof. W. D. Marks of the Philadelphia Edison Co., and Mr. Albert A. Cary of the Abendroth & Root Mfg. Co., also testified as experts on their respective sides.

THREE-WIRE LITIGATION AT ELGIN, ILL.

The Elgin, Ill., Electric Illuminating Company has been served by the General Electric Company with a notice of suit for infringement of the Edison three-wire patent, No. 274,290.

THE GOVERNMENT TELEPHONE SUIT.

In his annual report the U. S. Attorney General, Judge Harmon, asks Congress to direct him what to do in the Bell telephone litigation. The expense of this case, he says, is very heavy. It will take six months to prepare rebuttal testimony. He favors continuing the case to a final decision, provided the expenses can be met, and says: "If the people have been deprived of their natural rights by the improper issue of a patent, as the Government avers, it would not be a proper course on its part to discontinue litigation, which has probably been purposely protracted until the patents have expired, but such litigation should be persisted in to establish finally, for the sake of future action on its part, its right to sue to annul patents."

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED DEC. 3, 1895.

Alarms and Signals:—

Electrical Protective Appliance, A. H. McCulloch, Boston, Mass., 550,638. Filed Sept. 14, 1895.
A protective appliance consisting of an easily fusible conductor surrounded by asbestos in a loose and porous state.
Signal Circuit, J. V. Young, Boston, Mass., 550,670. Filed July 8, 1893.
Indicates the presence of the front or rear end of a train at a certain predetermined point by the employment of only one track battery and relay.
Speed Indicator and Alarm, F. Blumenstein and A. E. Bobsien, Mt. Vernon, N. Y., 550,775. Filed May 13, 1895.
Electric Time-Alarm Attachment, M. Wolff, New York, 550,857. Filed July 3, 1895.

Conductors, Conduits and Insulators:—

Crossover Insulator, F. G. Beron, Waterbury, Conn., 550,673. Filed Feb. 18, 1895.
Method of Making Compound Wire, H. A. Williams, Taunton, Mass., 550,705. Filed Nov. 28, 1890.
The method of making composite telegraph or other electric wire comprising a core of metal having high tensile strength, and the other part being a conductor of high quality, by stringing on the core wire two or more shorter tubes than said wire, welding said tubes together at the ends, and reducing both the tube and the core down by gradual reduction in a cold rolling process and compressing the tube on and uniting it with the core.

Distribution:—

Method of Distributing Electricity to Electric Lighting Systems, C. M. Davis, Chicago, Ill., 550,782. Filed Apl. 14, 1892.
The combination of a source of electrical energy of continuous direction, a converter, synchronously operated alternators in the primary and secondary circuits, said alternators being set at different phases, whereby the current in the secondary circuit is rendered uniform in direction and more even in strength.

Dynamos and Motors:—

Dynamo Electric Machine for Plating, W. M. Thomas, Chicago, Ill., 550,663. Filed Mch. 25, 1893.
A dynamo which will produce two or more currents of different potentials and varying quantity of amperes.
Dynamo Electric Machine, H. P. White, Kalamazoo, Mich., 550,666. Filed Jan. 29, 1895.
A machine designed to give simultaneously alternating and direct currents, or a number of alternating currents, etc.
Armature, H. G. Reist, Schenectady, N. Y., 550,692. Filed Aug. 31. 1895.
In a monocyclic armature, the combination of a core having notches of different sizes, a series of main coils in the larger notches, and a second series of smaller or "teaser" coils in the smaller notches, one end of the series being connected to the middle of the series of main coils.
Commutator, H. P. White, Kalamazoo, Mich., 550,703. Filed Jan. 29, 1895.
Details of a commutator for obtaining various types and combinations of current.

Electrometallurgy:—

Holder for Electroplating, E. R. Allen, Wallingford, Conn., 550,812. Filed Sept. 30, 1895.
The object of this invention is to construct a holder in which the spoons or forks are readily arranged and which may be turned to submerge opposite ends of the articles.

Lamps and Appurtenances:—

Electric Arc Lamp, T. E. Adams, Cleveland, O., 550,574. Filed March. 14, 1895.
Details relating to a constant potential lamp.
Electric Arc Lamp, S. Doubrava & J. Donat, Brünn, Austria-Hungary, 550,600. Filed Feb. 2, 1895.
A combination of solenoids, iron cores, and shells or casings so arranged that the carbon-holders are directly and movably connected either with the core or with the solenoid, while the other part of the electromagnet is immovable.

Lighting:—

Electric Car-Lighting Apparatus, W. Biddle, Brooklyn, N. Y., 550,860. Filed Jan. 7, 1895.
Relates to automatic switching arrangements of a system in which the dynamo is driven from the car axle.

Measurement:—

Voltmeter, F. Holden, Schenectady, N. Y., 550,632. Filed Aug. 31, 1895.
An instrument of the electrodynamometer type for alternating or direct currents.
Electric Meter, T. Duncan, Fort Wayne, Ind., 550,823. Filed May 22, 1895.
Details relating to an alternating current wattmeter.
Electrical Measuring Instrument, H. C. Parker, Brooklyn, N. Y., 550,841. Filed May 9, 1895.
An instrument adapted to be used both as voltmeter and ammeter.

Miscellaneous:—

Temperature Regulator, C. A. Howard, Detroit, Mich., 550,618. Filed July 15, 1895.
Has reference to an improved temperature regulator for automatically controlling the draft of furnaces and analogous devices.
Electric Cigar Lighter, J. F. McLaughlin, Philadelphia, Pa., 550,686. Filed Apl. 24, 1893.
An electric cigar lighter comprising a heating conductor disposed between layers of asbestos with a superposed sheet of wire gauze.
Electrotherapeutic Apparatus, C. Palmleaf, Seattle, Wash., 550,688. Filed Apl. 1, 1895.
Self-Winding Electric Clock, C. M. Crook, Chicago, Ill., 550,822. Filed Mch. 25, 1895.
Workman's Time Recorder, W. Whitehead, Manchester, Eng., 550,856. Filed Aug. 22, 1894.
Electric Furnace, F. Chaplet, Laval, France, 550,866. Filed May 29, 1894.
In an electric furnace, the heating chamber, the hollow retort extending into the same to contain the material to be heated, and the carbon pencils arranged to form an arc adjacent to the retort, said retort having its inlet end outside the walls of the furnace and closed by a suitable stopper.

Railways and Appliances:—

Trolley Wire Crossing, J. C. Kinney, San Antonio, Tex., 550,683. Filed Apl. 17, 1895.
Elevated Carrier, W. F. Brothers, Philadelphia, Pa., 550,777. Filed Jan. 8, 1895.
A telpherage system with auxiliary electric conductor.
Automatic Electric Switch for Railways, R. V. Cheatham, Louisville, Ky. 550,868. Filed Mch. 7, 1895.
In an electric railway, the combination with a series of movable switches, rails at different points, of current boxes containing circuit closing levers having their ends arranged at different heights upon one side of the trolley wire, solenoid-magnets having core-bars connected to the switch-rails, and trolley-staffs upon the several cars having rigid spurs arranged at different points upon the trolley-staff, whereby said spurs are enabled to engage the ends of the circuit closing levers, placed at corresponding heights.

Switches, Cut-Outs, etc.:—

Electric Switch, C. Bach, Jr., Milwaukee, Wis., 550,577. Filed Apl. 12, 1895.
A quick-break knife switch.
Electric Safety Device, E. Thomson, Lynn, Mass., 550,733. Filed May 19, 1887.
The combination with electric mains supplying devices in multiple of a lightning arrester for both poles of the circuit, an arc rupturing magnet or magnets for rupturing an arc following a discharge over either pole, and means for rupturing a cross or short circuit from one main to the other through the lightning arrester resulting from a discharge to ground from both mains together.

Telegraphs:—

Permutation Selector, A. B. Strowger, Chicago, Ill., 550,658. Filed June 14, 1894.
Finger keys, which are provided with contacts arranged in permutatical order, whereby but one key of the whole group is capable of being placed in electrical communication with the same relative combination of the line wires.

Telephones:—

Automatic Telephone Exchange System, J. G. Smith, New York, 550,728. Filed Feb. 18, 1893.
Details relating to switching arrangements, etc.
Automatic Exchange System, J. G. Smith, New York, 550,729. Filed Feb. 20, 1893.
Details referring to above.
Signaling Apparatus for Telephone Switchboards, C. E. Scribner, Chicago, Ill., 550,765. Filed Apl. 16, 1895.
A slight variation in the signaling current lights the annunciator lamp.

CLASSIFIED DIGEST OF U. S. PATENTS ISSUED DECEMBER 10, 1895.

Alarms and Signals:—

Signaling Apparatus, B. J. Noyes, Boston, Mass., 551,090. Filed Sept. 11, 1889.

The bell responds to some signals, as the special signals, and not to other signals, as the patrol or post signals.

Successive Non-Interfering Signal Box, W. H. Kirnan, Brooklyn, N. Y., 551,125. Filed Aug. 18, 1890.

Object is to prevent interference between two or more signal transmitters arranged in series on a single line and to remove all the resistance of the magnets from the line at all idle boxes or transmitters.

Conductors, Conduits and Insulators:—

Cleat for Electric Wiring, J. R. Hemphill, Akron, O., 551,088. Filed Sept. 26, 1895.

Has wedge-shaped receptacles to hold various sizes of wires.

Joint for Insulated Electric Wires, R. S. Kelsch, Chicago, Ill., 551,166. Filed Dec. 22, 1894.

The joint is covered by a taper screw sleeve.

Composition of Matter for Insulating Purposes, R. N. Pratt, Hartford, Conn., 551,230. Filed Oct. 31, 1889.

Consists of dense hard rubber, laminated mica, and fibrous asbestos.

Distribution:—

Switch for Electric Plants, A. H. Lucas, Pittsburgh, Pa., 551,170. Filed Jan. 4, 1895.

The object of the invention is to provide for the connection of any generator of a plant with any supply circuit or feeder extending from the plant in such a manner as to avoid all liability of connecting two non-synchronizing generators to the same circuit.

Dynamos and Motors:—

Commutator Brush, R. Hirsch and H. Meminger, Milwaukee, Wis., 551,083. Filed Jan. 28, 1898

Constructed of alternating strips of carbon and metal.

Electro-Metallurgy:—

Electric Smelting Furnace, J. A. Vincent, Philadelphia, Pa., 550,014. Filed July 18, 1895.

The ores are automatically fed horizontally between the two electrodes.

Lamps and Appurtenances:—

Carbon Holder for Arc Lamps, H. J. Farley, Philadelphia, Pa., 550,956. Filed Dec. 15, 1894.

Details of construction for self-centering.

Electric Arc Lamp, W. J. Davy, London, Eng., 551,099. Filed Apr. 19, 1895.

An improved arrangement for striking and maintaining constant the arc, and improved means for adjusting the lamp according to the potential of the circuit in which it is to work.

Electric Arc Lamp, F. N. Pike, New York, 551,046. Filed June 27, 1894.

The upper carbon is attached to a sleeve nut on a screw turned by the regulating mechanism.

Electric Arc Lamp, W. P. Wiemann, Washington, Pa, 551,244. Filed Apl. 17, 1895.

Automatically compensates for the loss in weight of the upper carbon.

Electrode for Arc Lamps, T. G. Portis, St. Louis, Mo., 551,257. Filed May 14, 1895.

A tapered electrode.

Miscellaneous:—

Paper Registering Machine, T. C. Dexter, Pearl River, N. Y., 550,950. Filed Oct 26, 1894.

A circuit closer in the path of the paper to be actuated thereby.

Electric Clock, B. Franklin, Dec'd, M. A. Franklin, Administratrix, Chicago, Ill., 550,959. Filed Apl. 1, 1893.

An impulse is imparted whenever the arc of vibration of the pendulum is less than a given distance.

Electromagnet, S. T. Wellman, Upland, Pa., 551,030. Filed Apl. 18, 1894.

Specially constructed for lifting large sheets of metal and protected from atmospheric influences

Antisparkle Commutator Compound, J. R. Davis, New Iberia, La., 551,268. Filed Mch. 30, 1895.

A compound containing sperm, graphite mixed therewith and chalk

Electric Sunshine Annunciator, L. Hunt and F. W. Duenckel, St. Louis, Mo, 551,284. Filed May 20, 1895.

Two connected vessels filled with water and hinged so as to oscillate. One of the vessels is blackened and the other bright. The absorption of heat by the former expands the air and forces the liquid into the other, causing oscillation, which is registered electrically.

Railways and Appliances:—

Bond or Connector, A. G. Carlson, Chicago, Ill., 550,941. Filed July 18, 1895.

A metal wire rod or bar with expanded terminals.

Electrical Conduit Railway, J. D. Griffen, New York, 550,965. Filed Dec. 5, 1892.

The slot is normally closed by a pivoted interior shield, which is moved aside when the car passes.

Electric Rail Bond, W. H. Wiggin, Worcester, Mass., 550,031. Filed May 22, 1895.

The bond rod carries a collar which fits into a thimble in the rail rib.

Electric Controller, S. H. Short, Cleveland, Ohio, 551,053. Filed Aug. 26, 1895.

For description see page 599 this issue.

Electric Controller, S. H. Short, Cleveland, O., 551,054. Filed Aug. 27, 1895.

Similar to above.

Switch for Underground Electric Railways, A. Rosenholz, San Francisco, Cal., 551,145. Filed April 12, 1895.

Trolley, D. Lippy, I. E. Finfrock, G. A. Rinehart and D. R. Francis, Mansfield, Ohio, 551,168. Filed Sept. 24, 1895.

Relates to a trolley base.

Trolley, D. Lippy, I. E. Finbrock, G. A. Rinehart and D. R. Francis, Mansfield, Ohio, 551,169. Filed Sept. 24, 1895.

Modification of the above.

Electric Railway, R. Lundell, Brooklyn, N. Y., 551,334. Filed June 9, 1894.

For description see page 598 this issue.

Switches, Cut-Outs, etc.:—

Electric Switch, J. E. Criggal, Springfield, Ohio, 551,203. Filed Jan. 15, 1895.

An auxiliary brake takes the spark.

Telegraphs:—

Telegraph Relay, A. D. MacDonald, Melbourne, Victoria, 551,192. Filed Nov. 2, 1894.

Details of an improved polarized relay.

Telephones:—

Harmonic Selective Signal for Party Telephone Lines. J. A. Lighthipe, San Francisco, Cal., 550,962. Filed June 24, 1895.

A receiver in the form of a mechanically vibrated reed is provided at each of the several sub-stations, each of the reeds having a different and characteristic pitch.

Multiple Switchboard System. T. Spencer, Cambridge, Mass., and T. C. Wales, Jr., Boston, Mass., 551,056. Filed Mch. 18, 1895.

Improvement on Firman patent 252,576.

Telephone Circuits, J. S. Stone, Boston, Mass., 551,060. Filed July 6, 1895.

For description see page 594 this issue.

Telephone Transmitter, J. and H. M. Goodman, Louisville, Ky., 551,275. Filed June 14, 1895.

Relates to telephone transmitters of that class in which magnetic material in a finely-comminuted condition is interposed between a vibratory and a fixed or relatively stationary magnetic electrode.

Telephone Receiver, A. C. Brown, London, Eng., 551,347. Filed July 11, 1895.

A combined telephone and buzzer.

SOCIETY AND CLUB NOTES.

MEETING OF THE ELECTRICAL COMMITTEE OF THE UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION, NEW YORK, DEC. 10, 11, 12.

A meeting of the Electrical Committee of the Underwriters' National Electric Association was held at the Rooms of the National Board of Fire Underwriters' in New York City on Tuesday, Wednesday and Thursday, December 10, 11 and 12. There were present at the meeting the following members of the Electrical Committee, F. E. Cabot, Superintendent of the Inspection and Electrical Department of Boston Board of Fire Underwriters; C. M. Goddard, Secretary of the New England Insurance Exchange; William McDevitt, Inpector, Philadelphia Fire Underwriters Association; E. A. FitzGerald, Inspector Underwriters' Association of New York State; W. H. Merrrill, Jr., Electrician, Chicago Fire Underwriters' Association; A. E. Braddell, Inspector Underwriters' Association of the Middle Department; A. M. Schoen, Electrician, Southeastern Tariff Association; W. A. Anderson, Superintendent, Survey Department, New York Board of Fire Underwriters; others present at the meeting were President Nichols, of the National, of Hartford, Vice-President Washburn of the Home, of New York, Assistant Secretary Lowe of the L. & L. & G., of Atlanta; G. B. Lauder, Inspector, New Hampshire Board of Underwriters; J. E. Cole, Inspector, Boston Wire Department; G. W. Wilson, Inspector, Boston Fire Underwriters' Union; E. V. French, Inspector, Factory Mutual Fire Insurance Companies; Ralph Sweetland and J. Couilliard, Inspectors New England Insurance Exchange; J. C. Forsyth, Inspector, New York Board of Fire Underwriters; Frank Kitton, Inspector, Buffalo Association of Fire Underwriters; H. H. Hornsby, Chief Inspector City of Chicago; G. F. Bottom, Inspector, Kansas City Fire Underwriters' Association and M. L. Stern, City Electrician, Denver, Colorado.

As the work of the Electrical Committee of this Association has now become generally recognized throughout the United States by the various boards of Fire Underwriters which have adopted the rules as recommended by the committee, and as quite a number of cities have also incorporated these rules in their City Ordinances regulating the introduction and maintenance of electric light and power wiring, it may be of interest to give a brief sketch of the formation of the Association and the work which has been accomplished by the Association and its Electrical Committee.

In the summer of 1892 the Secretary of the New England Insurance Exchange after correspondence with the Electrical Inspectors of the Underwriters' Associations in the East called a meeting of the electrical representatives of the various Eastern Associations for August 18th at the Rooms of the National Board, in New York. This meeting was called without any specially prepared plan of action and it was not felt advisable to ask for representatives from Boards situated at a distance from New York City. The meeting, however, was more of a success than was even hoped for. The rules as adopted by the National Electric Light Association were taken as a basis and carefully considered and revised section by section. Proofs of the revised rules were sent to all the Underwriters' Organizations in the United States with notice that a second meeting would be held in New York City and with request that any suggestions in relation to the rules be sent to the Chairman of the meeting. These organizations were also advised that a plan for a permanent organization of the Electrical representatives of the Underwriters would be presented at the meeting and all were requested to send representatives to that meeting which was held on December 6, of the same year.

At the December meeting a permanent organization was formed called the "Underwriters' International Electric Association." (At a later date the name was changed to "The Underwriters' National Electric Association.")

The Articles of Association which have only been slightly changed since their adoption at this meeting provide "that any member, officer or employé of any Fire Underwriters' organization or Fire Insurance Company in the United States or Canada may become a member of the Association on application to the Secretary." The officers of the Association are a President, Vice

President, and Secretary and Treasurer. The Articles of Association also provide for an Executive Committee and an Electrical Committee. The last named to consist of nine members who shall be chosen from the electrical experts in the employ of the Insurance interests. The officers are also ex-officio members of the Electrical Committee. All meetings of the Association must be held at the National Board Rooms in New York City. The officers and electrical committee, which have remained unchanged since the organization of the Association, are as follows: President, C. E. Bliven, of Chicago; Vice President, W. A. Anderson, New York; Secretary and Treasurer, C. M. Goddard, Boston. Electrical Committee, F. E. Cabot, of Boston, Chairman; William McDevitt, of Philadelphia; George P. Low, of San Francisco; A. E. Van Geisen, of New York; E. A. FitzGerald, of Syracuse; Edward Leloup, of New Orleans; W. H. Merrill, Jr., of Chicago; A. M. Schoen, of Atlanta, and A. E. Braddell, of Philadelphia.

At this December meeting the rules formulated at the August meeting were again carefully gone over and amended as seemed necessary, after which every person present agreed to recommend to their respective Associations that they be adopted as the standard for the territory under their jurisdiction.

The next meeting of the Electrical Committee was held on August 17, 1893, in Chicago, and an adjourned meeting was held on September 5th, in Boston. As the rules adopted at the meeting in 1892 had then been in use by most of the principal Underwriters' Associations for nearly a year, the Committee had the advantage of suggestions and criticisms drawn from the actual application of these rules, and they were again carefully taken up section by section, and such changes and additions as experience seemed to indicate to be desirable, were adopted.

At this meeting, also, the word "approved" which was frequently used in the first edition of the rules to describe wires and devices was defined, and these definitions were incorporated in the rules themselves. A list of wires which had been found to comply with the requirements of the rules was also published, and a resolution was adopted calling attention to the liability of the destruction of metallic substances, especially water and gas mains, buried in the ground, by electrolysis due to the ground return of single trolley street railway systems. This resolution was sent to the various Boards of Underwriters to call their attention to a matter which was of practically very recent development, and correspondence was invited on the subject.

The work of Mr. Merrill in Chicago in connection with the Electrical Committee is worthy of special notice. Starting first with the idea of collecting and distributing as full information as possible in regard to fires due to electricity, he has gradually established a department which is of great assistance not only to the electrical inspectors of the country, but also to the insurance companies and their various field representatives. His Fire Reports on behalf of the Committee have become well known and have, no doubt, had the tendency to lessen the number of electrical fires by calling the attention of the various inspectors to the probable causes which may develop an electrical hazard, as shown not simply in the experience of one man or in one particular section but in the experience of many inspectors covering nearly the whole territory of the United States.

Further than this he has established a testing bureau and a system of distributing reports of the results of the tests there made so that every inspector has the advantage of the experience and knowledge developed by a fully equipped and well managed testing laboratory. These reports have been of inestimable value in ridding the market of cheap and poorly constructed material and devices. The reputable manufacturers, being glad to remedy any defects shown in these reports, have improved their devices, and the goods of other less reputable parties have been to some extent driven from the market. It is the duty of every Insurance Inspector, and it is hoped that it will be the pleasure of all connected with the electrical interests, to furnish Mr. Merrill with as full data as possible relating to electrical fires and devices and materials which may come to their attention.

The next meeting of the Electrical Committee was held in New York on December 19, 1894. The changes in the rules made at this meeting were very few, but quite a large number of general subjects were taken up and considered and referred to special sub-committees. The most important action taken at this meeting, however, was the adoption with the sanction of the Committee on Lighting of the National Board, of a resolution that the members present at the meeting would urge upon their respective Associations an agreement to adopt and use the rules for safe wiring as adopted by the National Board of Fire Underwriters on the recommendation of the Electrical Committee, and that these rules should be printed only by the National Board and that no changes or additions should be made except as promulgated through the National Board. The adoption of this resolution and the acceptance of the plan proposed by practically all of the Underwriters' Associations of the United States at last brought about the result which was chiefly in the mind of the Secretary of the New England Insurance Exchange when the first meeting was called, that is, an absolutely uniform set of rules for Electric Light and Power wiring throughout the United States. Tthat this result has been accomplished, is shown by the fact that forty Underwriters' Associations have ordered copies of these rules all printed from the same type.

The Electrical Committee, feeling that the adoption of the rules recommended by them, by the National Board and nearly all of the Underwriters' organizations and their incorporation in the ordinances of some twelve or fifteen cities had established the fact that their work had proved itself, so far as these rules are concerned, to be practical and satisfactory as a whole, considered that they were now in a position to invite general criticism from all those engaged in the electrical business. (The rules had previously been submitted to and approved by representatives of the most prominent electrical manufacturers and central station men.)

Early in October, 1895, the Committee sent out a circular letter with blanks, practically broadcast, inviting such suggestions for changes or additions in the present rules as could be made and supported by what to the person making them seemed to be good and logical arguments for their adoption with a statement that these suggestions should receive careful consideration at the meeting in December of this year. A very large number of suggestions were received and this brings us to the meeting of the Electrical Committee which has just closed its sessions this past week.

At this meeting the discussions and votes were not confined to the Members of the Electrical Committee but the full privileges of both discussion and voting were extended to all present.

Chairman Cabot opened the meeting with a short address, the recommendations in which were referred to a special committee and on their recommendation, the following resolutions were adopted:

Resolved: That any increase of voltage on interior incandescent lighting circuits would result in a corresponding increase of danger to life and property, and that owing to the tendency toward the introduction of high voltages it be urged that extreme care by taken by Inspectors and others in charge of such installations without which we believe serious hazards may be incurred;

Resolved: That the members of this Committee and other Electrical Inspectors, here present, pledge ourselves to exert our influence to further the enforcement of the rules and requirements of the National Board of Fire Underwriters and to co-operate with the Electrical Bureau of said Board in furnishing that Bureau with facts which come under our observation regarding devices and materials which may not be constructed in accordance with these rules and the introduction of which would create a hazard to property;

Resolved: That we further agree that all Bureau reports received setting forth such facts shall receive careful consideration and the findings of the report be followed out as far as possible in our respective territories, to the end that co-operative work along these lines may be established and uniformity of action in all essential matters secured;

Resolved: That the introduction of trolley wires in municipal districts is inimical to the safety of the property of the inhabitants of such districts, and that because of this fact all possible precautions should be taken by the managers of trolley roads throughout the country, to insure cutting the current off of the wires in case of fire in abutting property; also that trolley wires should be effectually protected against the possibility of contact between them and other conductors; also that trolley systems should be so arranged, that practically no difference of potential due to the effects of trolley roads should exist between subterranean pipes.

A Committee consisting of Messrs. French, Goddard and Sweetland, was appointed to consider and report on the question of how best to guard against the hazard due to the possibility of the breaking down of the insulation between the primary and secondary transformer coils. This subject being considered of importance, especially in view of the tendency towards extremely high voltages in long distance transmission. The matter of preparing rules to govern marine wiring was referred to Mr. Sweetland for a report.

The subject of protectors which should obviate the hazard due to the liability of wires, such as telegraph, telephone and similar signal wires becoming crossed with electric light or power wires, was referred to a Committee consisting of Messrs. Cabot, French and Merrill.

The above committee will report at a later date.

The Secretary was instructed to submit his proof of the revised rules as taken from the minutes to the different members of the Committee before sending to the printer. He was also instructed in accordance with suggestions made by several parties that in compiling the rules the definitions be incorporated in the rules themselves instead of printed as an appendix.

It was voted that the Secretary advise all persons who sent in suggestions which were not adopted of the reasons given by the members of the Committee for their rejection.

The changes made in the rules while they were considerable in number were very few of them radical and the general class of work which now receives the approval of the Underwriters under the present rules will not be greatly affected. It seemed to be the general opinion of those present that the rules were working satisfactorily both to the insurance and electrical interests and that only such changes should be made as were necessary on account of the progress of the electrical industry itself or where experience had shown that additions to the present rules were required.

The following are some of the more important changes made, and are given in the order of the sections amended in the present rules.

The grounding of the frames of generators may be allowed when necessary, by written permission. This change being made on account of the introduction of direct connected and extremely large and heavy machines.

Switches for motors must hereafter plainly indicate whether the current is on or off.

Rules were adopted requiring wires to be protected from mechanical injury in buildings, when necessary; high potential wires by substantial boxing giving a reasonable air space, and low tension wires either by boxing or by an approved iron armored conduit tubing.

It was ruled that the mesh of wire netting for arc light globes should not exceed 1¼ inch.

Switches on hanger-boards must cut out both poles of the lamp.

The use of wire smaller than No. 14 B. & S., will not hereafter be allowed except for pendant and fixture work.

The rules as to the construction and painting or filling molding were made more explicit.

The rules for special wiring in breweries, etc., will require that joints and splices be avoided as far as possible and that switches in damp places be mounted on porcelain knobs so as to give an air space behind them.

It will hereafter be allowable to draw strings into conduits for the purpose of pulling in the conductors, which should not be placed in the conduit until the mechanical work on the building has been completed as far as possible.

Hereafter cut outs will not be allowed in the canopies or shells of fixtures.

Hereafter circuits must be arranged so that no group of lamps (whether on the same fixture or not) requiring a current of more than 6 amperes will be allowed to be ultimately dependent upon one cut out, except that special permission may be given in writing for departure from this rule in case of large chandeliers.

Steps were taken which will tend to improve the character of double conductor; and hereafter except for pendants and fixture work a solid rubber insulation protected by durable braid will be required for flexible conductors.

Supports for motor ceiling fans must have an insulator interposed between them and the motor.

The electrical requirements of the standard for car barns and repair shops as contained in the schedule now used by a number of rating organizations are now to be incorporated in the rules.

Service switches must disconnect all of the wires entering the building; that is, on the three wire system, all three wires must be opened by operating the switch.

The use of brass sheathed Interior Conduit and Vulca tubing will not hereafter be approved for bushings.

The use of incandescent lamps in series circuits for decorative purposes will be allowed by special written permission when installed in a proper manner.

Rules for electric heating apparatus were adopted which will require in addition to the general wiring being done in accordance with rules, that the switches shall plainly indicate whether the current is on or off; that the attachment of the feed wires be in plain sight; that stationary heaters be treated as stoves and that the flexible conductor necessary for use with flat irons and other devices of a similar nature shall have an insulation that will not be injured by heat, such as asbestos, which insulation must be protected from mechanical injury by a substantial outer braiding.

The above constitute the principal changes in the rules.

The suggestion that the table of safe carrying capacity for wires was too near the actual limit of safety was referred to the Chairman of the Committee, for tests, investigation and reports.

The matter of obtaining more effective and more efficiently constructed devices for automatic safety cut outs was referred to the Committee on Tests with request that they obtain all the information possible in relation to the proper construction of fuse blocks, length of fuses and efficiency of fuse metal in connection with currents of various quantity and potential.

The attention of the Committee was called to the fact that it was claimed by storage battery experts that these batteries were extremely subject to damage by water in case of fire.

The Committee on Tests were requested to report a standard for iron or steel armored conduit which should meet the approval of the Committee.

A communication from Mr. Edward H. Johnson of the Interior Conduit and Insulation Company setting forth the merits of that class of wiring, especially that of the iron armored conduit and suggesting that insurance companies should encourage this class of construction by a reduction in the premium on risks so wired, was read and placed on file.

AMERICAN STREET RAILWAY ASSOCIATION MEETING.

Mr. T. C. Pennington, secretary and treasurer of the above Association informs us that at a meeting of the Executive Committee held in St. Louis, December 9, the Southern Hotel was selected as the headquarters of the Association. The meetings will be held in the Olympic Theatre, opposite the Hotel. The Exhibition Hall has not been selected as yet, but will be in the near future.

The local committee at St. Louis are straining every nerve to make it the most pleasant Convention ever held.

The committee suggests that delegates and visitors secure hotel accommodations at as early a date as possible, as Mr. Lewis, manager of the hotel, will make reservations for all who apply.

MICHIGAN ASSOCIATION OF STREET RAILWAY MANAGERS.

The State Association of Street Railway Managers held its annual meeting at Grand Rapids on Dec. 4, seven of the thirteen cities in the association being represented. J. P. Lee of Lansing read a paper on "Franchises," and several matters pertaining to the management of street railways were discussed. Officers for the ensuing year were elected, as follows: President, W. L. Jenks, Port Huron; vice president, W. Worth Bean, St. Joseph; secretary and treasurer, Ben S. Hanchett, Jr., Grand Rapids; all of whom are also members of the executive committee. Charles M. Swift, Detroit, and E. E. Downs, Bay City, were elected as the other members of the committee. The next annual meeting will be held the first Wednesday in December, 1896, the place of meeting to be decided by the executive committee.

OBITUARY.

MRS. EMILY WESTINGHOUSE.

Mrs. Emily Westinghouse, widow of the late George Westinghouse, sr., died at the Windsor Hotel, New York City, last week, at the age of eighty-six. Her maiden name was Vedder, and she was a descendant of one of the early Dutch families of Central New York. In 1828 she became the wife of George Westinghouse, sr., an inventor, who afterwards owned the Schenectady Agricultural Works. He died in 1885 at the age of seventy-five.

Mrs. Westinghouse was the mother of ten children, two of whom, George and Herman, are living. Three of her sons, John, Albert and George, served in the Union Army during the war. Albert was killed in battle.

MARRIED.

HARRIS—MELISH.

Mr. B. F. Harris, Jr., owner of the street car system at Champaign, Ill., was married in Cincinnati on Dec. 5 to Miss May Melish. Of the bride the Cincinnati *Times-Star* says: "She is a beautiful girl with glorious dark eyes, a wealth of waving brown hair, and a sunny, unselfish nature, which has won her a host of friends. She has been a great belle since her debut last season and the bride who has received more flattering attentions is not recorded."

REPORTS OF COMPANIES.

NEW YORK EDISON EARNINGS.

THE following is the November report of Treasurer Williams, of the New York Edison Co., for all the stations:—

	1895.	1894.	
Gross	$185,299.54	$178,544.28	$6,755.26 Inc.
Net	90,755.48	92,495 46	1,739 98 Dec.
Gross, 11 months	1,658,976.33	1,493,284.45	165,691.88 Inc.
Net, 11 "	799,189.36	716,443.10	82,746.26 Inc.

HARNESSING THE LITTLE FALLS, WASHINGTON.

Oscar T. Crosby, Chas. A. Lieb and others have consummated a deal with the owners of the property at the Virginia end of the Chain bridge, near Washington, whereby they have become possessors of real estate which carries with it rights to the water power of Pimmet run, and territory embracing an apparently inexhaustible quarry. Located on the property is a brick building, which at present contains the machinery, dynamos, etc., of the Potomac light and power plant. Preparations are now being made to remove this power machinery to Georgetown, where superior facilities for more extensive and economic operation exist. The land bought will permit an easy harnessing of the Little Falls power, and it is understood that this was one of the principal odjects of the purchase.

NAPA, CAL.—A new electric light and power company has been proposed which is to use petroleum for fuel, the oil having recently been tapped in Napa County. The oil is very cheap, while coal costs $6.50 to $8 per ton. Mr. Frances, of the *Napa Register*, is interested.

PUT A PREMIUM ON SAFE WIRING.[1]

BY EDWARD H. JOHNSON.

ARE we justified in assuming that both parties to insurance are ever seeking for safeguards against loss, and hence are alike willing to pay a premium upon added security? The insured, perchance, by a slightly enhanced investment, and the insurer by a slight abatement of rates. If we may so assume and we can demonstrate in a given system of electric wiring the existence of all known factors of safety as against the lack of many of these factors in all other systems, may we not rightfully expect and ask that the use of such a system be encouraged by the proffer of a reduced insurance rate? Should we not, in fact, expect its general use to be made compulsory by legislative enactment?

The very pronounced expression of opinion by many insurance authorities that the presence of electricity renders their risks extra hazardous, naturally suggests a guarantee of their practical co-operation in securing a premium on any system of protection which should minimize these risks by ever so little. And if it were possible to demonstrate the complete elimination of all risks, we should expect, not only their enthusiastic assistance but to see them taking the initiative in securing such mandatory legislation.

The purport of this article is to test the strength and sincerity of the belief in electric dangers, as well as the desire for a remedy; if it shall elicit a responsive echo, however faint, the writer stands ready to verify every claim hereinafter made affirmative of the virtues of the system in question.

IRON ARMORED CONDUIT.

From the haphazard stringing of poorly insulated wire minus all attempts at protection, through the several stages of wooden moldings, and thence through the early forms of unprotected insulating conduits to the modern metal sheathed insulating tube, though a long and tedious way has, nevertheless, taught an invaluable lesson, viz.: that no method of wiring is absolutely safe and reliable that does not possess in a superlative degree, these four factors of resistance: 1st., to heat; 2nd., to water; 3rd., to mechanical injury; 4th., to decay.

From this experience there has finally been evolved what must, in the nature of things, prove to be the ultimate standard, viz.: a system in which materials are employed affording the highest resistance to heat; the highest resistance to water; the highest resistance to mechanical injury; and the most stubborn resistance to decay, within the reach of the industrial arts.

Asphaltic treated paper tubes enclosed within iron pipe will neither let water in, or electricity out; will not burn, and cannot be broken; acids are foiled, and the heel of the hod-carrier leaves no impress. Internal electric fires exhaust themselves in fruitless effort at escape, and external miscellaneous fires find no conveying or perpetuating medium. In short, the agencies hitherto effective to let loose the "Destroying Angel" are all absent, and that awe-inspiring Fire Bug is compelled to tamely traverse in perpetuity the salamanderic corridors of a fire-proof tunnel, which properly constructed has no beginning and no ending, save in the open air, or in its subterranean continuation. To realize that one's treasures, animate or inanimate, are thus so absolutely isolated from the influence of the fell destroyer is to sleep, minus the perchance of a dream, and to acquire this somnolent, the insured has only to pay a slight advance on the price current for less beatific conditions, and the insurer needs only to abate by a small percentage the usual charge for his guarantee. Is this a theory, or is it a condition? The best method of answering is probably to contrast the new with the old. Let us take the alternatives as they have chronologically appeared:

1. *Wooden Moldings.*—Will not wood burn? Will it not absorb moisture? Will it not convey an electric current when moist? Will it not rot? That suffices; the "rot" and its consequences are too apparent, it had to go.

2. *Open Wiring on "Cleats," Porcelain Insulators, etc.*—Will wire insulation not decay in the open air? Will wires stretched never sag? Will wire insulation resist abrasion? Is such construction safe, sightly or scientific? Let that suffice; safe, sightly and scientific it is not, whatever else it may be. It likewise has passed.

3. *Plaster Imbedded.*—Note a pathway strewn with disaster, bad temper, and financial loss; material so employed as to hasten and ensure its decay, thus begetting the necessity for its early re-creation and at a quintupled cost. Decay is the one inexorable law of Nature, and he who heeds not this fact will pay the price, "Attix" to the contrary, notwithstanding.

Conduits, Unprotected.—Here we have a new departure. The law of decay, in respect of the wires at least, is recognized, and provision made for their ready and quick rejuvenation. But as to the conduit itself, moths (acids) still corrupt and thieves (nails) still break through and steal, so even yet we are not entirely safe, and must need take another step.

In this category may be classed my original unprotected paper tube, but more particularly the so-called flexible conduits, now contending for popular favor, on the ground of low cost and facility of use. Of its virtues, nothing can be said, that is not comprehended in the word "cheapness"; heat, water, the heel of the hod-carrier, and the tenpenny nail and even its most boasted virtue "flexibility" are alike its mortal foes, one and all operative to rob it of efficient and permanent utility.

Conduits, Protected.—Here we advance on right lines. Now, moths do not corrupt, but thieves may break through and steal. Still the law of decay is observed. The acid moth of corruption is frustrated, fire has no terrors and a fair degree of invulnerability is secured. Enough, in fact, is attained to satisfy ordinary demands, but not the demand for finality. To attain this, we must yet progress a stage, before we finally rest.

The Iron Armored Champion.—Here we rest. There are no more worlds to conquer, so long as wires are employed as conductors of electric energy. So long as electric currents obey natural laws and seek the shortest path home; so long as cognizance must be taken of the destructive elements: violence, disintegration, fire, water, and ignorance, as factors in the electric art, just so long will an insulating conduit, enclosed within an iron pipe be demanded. It alone will serve and suffice to give a quietus to the hitherto unanswered query, which has been for more than a score of years wandering around helplessly and and almost hopelessly in the architectural, mechanical and electrical brain: "How can we make electric wires safe?"

If then we now have an undisputed solution of an erstwhile serious problem, why not recognize the fact in a practical way? Why not, in fact, offer a premium on its adoption, and thus put an end to the extra hazardous risks about which we prate so much? Would this not be a more logical course for insurance authorities to pursue, than to authorize and approve methods which are utterly lacking in every essential element of safety and permanency?

1. A paper read at the meeting of the Underwriters' National Electric Association.

ELECTRICITY IN POWDER MILLS.

"THE appetite comes while eating," say the French, and that the same principle may be truly applied to the use of the electric motor is emphasized by certain experience which the General Electric Company has recently had with the Aetna Powder Company, of Aetna, Ind. In November, 1894, this Company decided to install two small slow speed generators for operating incandescent lamps on the Edison three-wire system. As these could not be delivered immediately, two second-hand machines were installed temporarily, and before the first two new ones ordered could be delivered, the order was changed to two larger moderate speed generators, with the privilege of changing them for two still larger ones. In June, 1895, the last two were ordered, together with two motors, one of one horse power, the other of five horse power. On August 2, the Aetna Company ordered another motor of 5 H. P. and on August 14, still another of the same capacity. The Company having enlarged its plant during the summer, found its electrical installation insufficient and on October 12 ordered two 45 kilowatt moderate speed generators, and two moderate speed motors, one of 20 H. P., the other of 30 H. P. Thus within one year electricity had given the Powder Company such satisfaction that it now has 66 H. P. in motors and 98 incandescent lamps taking current from the two 45 kilowatt generators. The one H. P. and the 5 H. P. motors are used to drive small mixing machines in the manufacture of dynamite. The 30 H. P. motor operates a large machine used for pulverizing nitrate of soda and the 20 H. P. runs a number of machines such as the dry pan and mixing machines. The Powder Company found that the first 5 H. P. motor, which they substituted for a steam engine, readily performed a duty which the engine found difficult to keep up with.

The recent gradual increase in the use of electric power in powder mills is especially noteworthy. During the past year the General Electric Company has equipped several with electric motors and present indications point to the speedy complete elimination of the steam engine from the operation of machinery in and about powder manufacturing establishments.

THE KNOWLES STEAM PUMP WORKS CALENDAR.

The Knowles Steam Pump Works have issued a calendar for the coming year which may well be considered a work of art. In size it is twenty by twenty-five inches. The centre is a handsome lithograph of Diana in all her magnificence, surrounded by the starry host, while supported by the electric rays flashing from her arrow's head are the figures 1896. At the top appears the name of the company in bright letters and at the sides and bottom are shown several of their pumps. The background is formed of scroll work of a subdued color greatly heightening the effect.

This concern manufacture a large variety of duplex and triplex steam and electrically driven pumps for all uses as well as sinking pumps and air compressors. They make a specialty of electric mining pumps.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

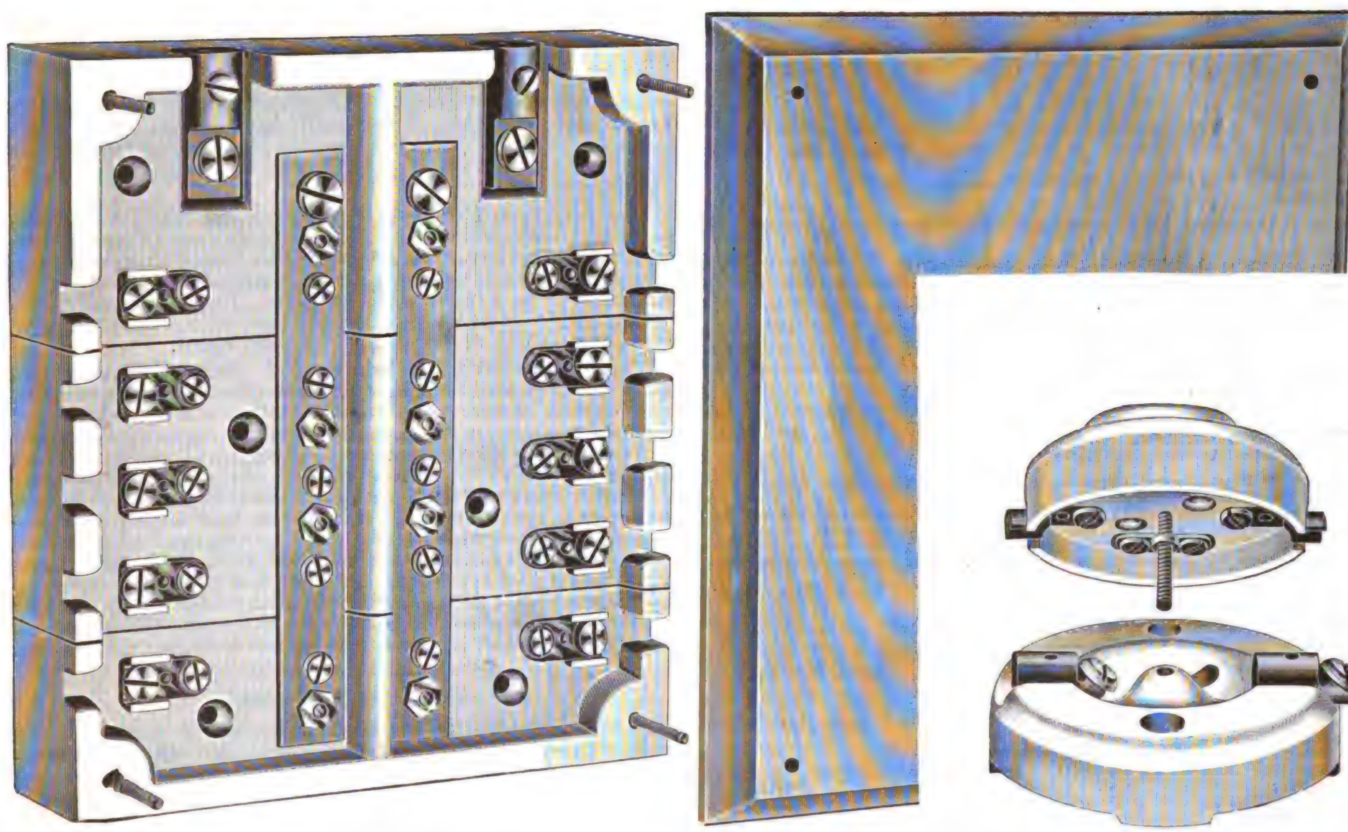
THE LEONARD ELECTRIC SOLDERING IRON.

THROUGH the courtesy of Mr. H. Ward Leonard, president of the Carpenter Enamel Rheostat Co., we have received one of the latest forms of the Leonard electric soldering irons made by the company. The instrument which scarcely weighs a pound is specially designed to use such a small amount of current as not to blow the lightest fuse used in practice; large devices of course are made on the same general lines.

We have had occasion to test the iron connected to the office electrolier and find it to be a remarkably handy little device. Though small in compass and exceedingly light there is nothing whatever of the toy about it. It is most substantially made and neatly finished and is evidently designed for rough usage. There ought to be a large demand for a handy little tool of this type.

NEW "PERU" MULTIPLE CIRCUIT BOARD AND ROSETTE CUT OUT.

WE herewith illustrate the new multiple circuit board which has recently been put upon the market by the Peru Electric Mfg. Co., Peru, Ind. This board, as will be seen by reference to the cut,



NEW "PERU" MULTIPLE CIRCUIT BOARD AND ROSETTE CUT OUT.

can be built in any number of circuits and is beyond doubt the most convenient thing of the kind thath as ever been placed upon the market. Since the introduction of this block, the old system of wiring is being radically changed. Instead of having numerous fuse blocks, scattered over a building, the fuses are all centered in this one block, which being placed in a central location, saves time and trouble in looking after the fuses.

The new Peru rosette cut-out, also herewith illustrated, is an article of considerable merit. It is adapted for either cleat or concealed work. The workmanship and material is of a high character and quality.

THE NATIONAL ELECTRICAL MFG. Co., Milford, Conn., J. G. Noyes, secretary and general manager, report that they are very busy, having lately taken on a number of hands and secured contracts for a large amount of new work, chiefly in their regular lines of manufacture; the concern being successor to the electrical department of the New Haven Clock Co.; the Microphone Carbon Battery Co.; the Porter Electric Messenger Co., and the Splitdorf Wire Co.

PHOENIX CARBON MFG. CO.

The Phoenix Carbon Mfg. Co., of 2134 DeKalb St., St. Louis, in view of the rapid increase of their business in all departments, and the bright outlook, have increased their capital from $100,000 to $250,000, fully paid up. The new capital will at once be devoted to the enlargement of the plant and to securing new facilities for the transaction of business. The directors are very sanguine as to the future.

THE NEW AMERICAN TURBINES OF THE DAYTON GLOBE IRON WORKS CO.

We have received an illustrated catalogue of the New American turbines of the Dayton Globe Iron Works Co., Dayton, Ohio. The New American wheel of this company is a solid or continuous casting, formed entirely by dry sand cores. It has even, true, and smooth surfaces, and is built to withstand the pressure of any head. The enormous strength of the wheel is indicated by the fact that the 66-inch size casting weighs considerably more than 6,000 pounds. The prominent points of superiority which the Dayton Globe Iron Works Co. have sought to embody in the "New American" are: economical use of water and high efficiency at all degrees of gate opening; great power for the diameter; steadiness of motion under all heads, and the ease with which it may be regulated for varying loads with a governor; great strength and durability to make it capable of standing the strain of any head; freedom from trouble with the step; freedom from becoming clogged with ice in the coldest weather; accessibility to all its parts.

The catalogue contains copious tables, measurements and instructions for the effective utilization of the turbines, paper and and pulp mill machinery gearing, shafting, pulleys, etc., manufactured by the Dayton Globe Iron Works Co., who are the successors to Stout, Mills & Temple, Dayton, Ohio.

TELEPHONIC WORK IN NEW YORK CITY.

The Metropolitan Telephone and Telegraph Co. advertises in our pages this week its special and attractive rates for service, which should do much to increase its patronage. It is also issuing some very cleverly written literature on the general subject and on the special point of "Busy," explaining what it means, and how each subscriber may do something to lessen that "necessary evil."

MEDBERY SLEET CUTTING TROLLEY WHEEEL AND PONY SWITCH.

Among the seasonable specialties offered by the Fiberite Co., of Mechanicville, N. Y., is a sleet cutting trolley wheel. Electric roads generally find it to their advantage to have on hand a few of these useful devices, and the one manufactured by the above company is giving good satisfaction wherever used. Its points of excellence will be readily apparent from the illustration.

MEDBERY SLEET CUTTING TROLLEY WHEEL AND PONY SWITCH.

The "Pony" switch also manufactured by the same company is having a well deserved sale by reason of the superior excellence of both material and workmanship. Manufacturers generally have seemed to think that almost anything would answer the purpose for a 15 amp. switch. The "Medbery Pony Switch" is made in the same manner and with the same regard to accuracy as those for 100 amperes and up, with polished slate base, polished bronze fittings and rolled copper blades. This has resulted in an enormous sale, which would tax the company to meet the demand, did it not have unusual facilities for manufacturing. The fact that these switches bear the name of Medbery, is a guarantee of good quality. The "Pony" switch is made in three sizes, 15, 25 and 35 amperes.

THE METROPOLITAN ELECTRIC CO.'S NEW CATALOGUE.

The Metropolitan Co. have been the recipients of several very complimentary letters regarding their new Catalogue from their customers and other friends, and we herewith give specimens of some they have received. The Company in their advertisement this week make a striking appeal to the eye with the beautiful figure of the Goddess of Magnetism and Attraction dancing a *pas seul* on a parcel of their books.

588 W. Congress St.,
Chicago, Dec. 5th, 1895.

MR. W. H. MCKINLOCK, Pres.,
Metropolitan Elec. Co., Chicago.

Dear Sir; Your illustrated catalogue No. 3 received. Please accept my thanks for the same.

It will puzzle the proverbial legal gentleman from Philadelphia to conceive of something in your line which is not found in this huge collection, whether it be a cord or a cable, a button or a battery, a dynamo or a door bell, or anything else that has even the most distant connection with that mysterious force we call electricity.

It is a perfect exemplification of the law of compressibility as so much has been crowded into so little space. I desire to compliment the compilers, and trust that the work they have done will be fully appreciated by a generous public and proper remuneration be your reward.

Very respectfully yours,
C. C. HASKINS.

Calumet & Hecla Mine,

Calumet, L. S., Mich., 11-9 95.

W. C. MCKINLOCK, Sec'y,
Metropolitan Elec. Co., Chicago, Ill.

Dear Sir: Your catalogue No 3 received, and in acknowledging receipt of same, must express my admiration at the way it is compiled. It is as good as an electrical dictionary and the wide margin left on the side of each page is invaluable to the buyer for notes, etc., making it without a doubt, the most complete and useful catalogue that the electrical profession has ever received.

Yours truly,
FRED N. BOPER, Elec.

These are but samples of the letters received from various parts of the country.

WESTERN NOTES.

EX-CHIEF ENGINEER JOHN A. GRIER, U. S. Navy, who is well known in electrical circles read a paper before the Loyal Legion entitled, "A Sketch of Naval life," on Thursday, December 12th, at their meeting held at Kinsley's, Chicago. The paper was very interesting as was evinced by the number of people who attended, there being about 400 present.

THE ELECTRIC STORAGE BATTERY CO. are now settled in their new Chicago offices suite 1543, 1544, the new Marquette Building, the accommodation at the old place being inadequate to the demands of their largely increasing business in the West. The offices are handsomely and comfortably furnished, and consist of the main office and a private room for the use of Mr. C. W. Woodward, the Western Manager of the Company.

ADVERTISERS' HINTS.

THE STANDARD AIR-BRAKE CO. publish a pleasing testimonial from a Hungarian Street Railway Co. who are using their apparatus and who mounted it themselves.

THE ELECTRIC APPLIANCE CO. call attention to Prof. Thomas' tests of Packard lamps and say that since they were published the sales have been largely increased.

THE FLEMING-SPENCER ELECTRIC CO., manufacturers of the Fleming alternating current arc lamp, claim for it, simplicity of design, handsome appearance, moderate cost, and absolutely steady light.

THE HICKLEY TRACK CLEANER BRUSH obviates the necessity of heavy plows and sweepers, each car doing its part to keep the road clean. They are easily adjusted and difficult to get out of order.

ANOTHER SIGN OF PROGRESS is found in the Greger noiseless manhole covers, over 1,000 of which are now in use in Philadelphia alone.

THE INDIA RUBBER AND GUTTA PERCHA INSULATING CO. have something to say in their ad this week about insuring cables and the point they make is easily sustained.

THERE IS SO MUCH TO BE SAID about the Calculagraph that the best thing to do is to write for information and a catalogue to The Calculagraph Co., 3 Maiden Lane, New York.

THE MICA INSULATOR CO., say that electrical engineers now specify "Micanite" as the proper insulation to be used.

THE BERLIN IRON BRIDGE CO., give a practical illustration of the meaning of "fire-proof doors." There is nothing so convincing as facts.

WESTERN NOTES.

CLEVELAND, O.—The new Rouse Block at Cleveland will be a very handsome building. Two Ball engines built by the Ball Engine Co., Erie, Pa., direct connected to dynamos built by the Elwell-Parker Electric Co., of Cleveland, furnish the lighting and power for elevators.

THE IMPROVED HUNNINGS TELEPHONE and telephone switchboard manufactured by the Electric Appliance Company continues to hold its ground as one of the most satisfactory outfits on the market. The telephone itself has been improved from time to time until it is a perfect instrument. The switchboard is a winner, and is operated more easily and with a less number of movements, it is said, than the regular Bell board.

ANTON CHRISTENSEN & CO., of 127 E. Indiana St., Chicago, report that they are receiving quite a large number of orders for their endless cotton belts from various users of high speed machinery, including some manufacturing concerns which are equipped with dynamos or motors that run up to 2,000 revolutions per minute. This concern is an offshoot of one of the same name at Dursley, England, where they have manufactured this class of belting for a long time, these belts being used largely in different parts of the world for cream separators, which sometimes make as many as 7,500 revolutions per minute. The claim made for the belt is that not having any joint it is perfectly smooth all the way through, and is guaranteed not to stretch or slip and to give much longer wear and satisfaction than the ordinary leather belt, where high speed transmission of power is used.

PHILADELPHIA NOTES.

PROF. W. D. MARKS, president of the Edison Electric Light Co., of Philadelphia, testifying before a Senate Committee investigating the municipal affairs of Philadelphia, said that his company would be glad to furnish the 5800 arc lamps now in use, at the rate of $100 per year each, or 30 cents per night.

NEW YORK CITY.

THE SUBWAY SYSTEM is alleged to be inadequate to the needs of the city. The Tenement House Commission has a report ready to present to the Gas Commission urging the placing of a large number of additional electric lights in the tenement house districts. Its suggestions cannot be acted on because the subways have not been provided.

NEW ENGLAND NOTES.

THE NATIONAL ELECTRIC CARBON AND MFG. CO. has been formed at Portland, Me., with a capital stock of $500,000, for the purpose of selling carbon machinery, carbons, &c. The officers are: W. A. Holmes, of Boston, president, and C. F. Clark, of Boston, treasurer.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE

Electrical Engineer.

Vol. XX. DECEMBER 25, 1895. No. 399.

Electric Lighting.

TESTS OF THE MOORE REGULATING LAMP SOCKET.

BY

Wm. A. Anthony.

THERE is one respect in which the electric light is a disadvantage in relation to gas lights. The latter, without extra apparatus, may be turned down to any desired intensity, furnishing a dim illumination for a sick room or sleeping room or hospital ward, or saving gas where the full illumination is not needed; while to do the same with an electric lamp has required an extra apparatus, costing nearly, if not quite, as much as the lamp and socket, and even then turning the lamp down by two or three steps or jumps instead of by a gradual process that would permit the use of any desired degree of illumination. The means by which this has been done on direct current systems is by the introduction of a resistance into the lamp circuit in series with the lamp, so reducing the current. This resistance absorbs energy and, therefore, wastes current, a matter that may be of some consequence when large numbers of lights are to be used at a very low candle power, and current is supplied by meter.

In September, 1893, Mr. D. McFarlan Moore read a paper before the American Institute of Electrical Engineers, in which he described a regulator consisting of a vibrating contact breaker in a vacuum, which dims the lamp by cutting off the current for a definite fraction of the time. The apparatus consists of a little electro-magnet about half an inch in diameter and three-eighths inch long, actuating a light armature attached to a vibrating spring which makes and breaks contact upon a suitable contact point. The whole, except the magnet, may be placed inside a tube an inch or so in length and of less thickness than a lead pencil. This apparatus, small as it is, scarcely becomes warm in use, there is hardly a visible spark at the make and break; it, therefore, cannot consume much energy. Almost the whole of the energy used is consumed in the lamp, and the lamp, therefore, at a given incandescence uses less current than when the regulation is effected by dead resistance.

The accompanying table gives the results of experiments made to determine the comparative energy saved by diminishing an incandescent lamp by the two methods. The lamp was run by a direct current, and was dimmed in the first instance by inserting a variable resistance. The candle power was measured by comparison with a Methven standard assumed to be two candles. Column 1 gives the candle power, Column 2 gives the potential difference between the terminals of the lamp. Column 3 gives the potential difference between the terminals of the resistance. Column 4 gives the current. Column 5 gives the energy consumed in the lamp.

Energy Consumed by an Incandescent Lamp at Different Degrees of Incandescence.

1	2	3	4	5	6	7	8	9	10	11
17.	115	0.	.62	71.30	0.	71.3				
10.	104	11.	.53	55.12	5.8	60.9	14.6	22.7	.48	.53
7.8	99.5	15.5	.50	49.8	7.8	57.6	19.2	30.1	43	.50
5.6	95.	20.	.47	44.7	9.4	54.1	24.1	37.3	.39	
4.0	91.	24.	.45	41.	10.8	51.8	27.3	42.3	.36	.38
3.2	85.	30.	.42	35.7	12.6	48.3	32.3	49.9	.31	.32
1.1	75.5	39.5	.36	27.2	14.2	41.4	41.9	61.8	.24	.26
0.33	65.	50.	.30	19.5	15.0	34.5	51.6	72.6	17	.19
.14	57.5	57.5	.265	15.2	15.2	30.4	57.3	78 7	.13	.15
.02?	45.	70.	.20	9.0	14.0	23 0	67.7	87.3	.08	

Column 6 gives the energy consumed in the resistance. Column 7 gives the total energy consumed. Column 8 gives the percentage of energy saved, as compared with the energy required to maintain full incandescence, when the lamp is dimmed by introducing dead resistance. Column 9 gives the percentage of energy that would be saved if the lamp were dimmed by the same amount and no energy used except in the lamp. Column 10 shows the mean current that the lamp should consume when dimmed by a vibrator, computed on the assumption that the vibrator consumes no energy. Column 11 gives the readings of a Weston amperemeter in circuit with the lamp when the latter was dimmed by the use of a vibrator to the candle powers given in Column 1. The vibrator used in this case had its spring so weighted that, in a horizontal position, with its contact point below and the magnet above, the spring would remain permanently in contact and the lamp burn at full brightness, the magnet, though in circuit, not having sufficient strength to lift the weight. Turning the vibrator through 180°, so that the contact point was above, the weight was sufficient to hold the spring out of contact and the lamp was extinguished. At intermediate angles, contact would occur, to be broken by the action of the magnet.

It is evident that, in different positions, the ratio of the time of contact to the whole time of vibration would vary from 0 to 1. When the time of contact was short and the lamp consequently dim, up to 2 or 3 C. P., the vibrator worked with absolute steadiness. The light was absolutely as steady as though dimmed by dead resistance. For higher incandescence the action of this vibration was somewhat irregular and the readings for these higher candle powers are, therefore, somewhat uncertain. It will be noted that below 4 C. P. the ammeter readings differ but little from the value of the mean current as deduced upon the assumption that the entire energy was consumed in the lamp. It will be noted also that, as the candle power becomes less, the current used when the lamp is dimmed by the vibrator bears a smaller and smaller ratio to that used when the dimming is effected by dead resistance. At .14 (1/7) C. P. the mean current with vibrator .15 ampere is only a little more than half the current with dead resistance. At this incandescence the filament was still at a bright red heat. Lower candle powers could not be measured by the photometer as arranged, but it was found that the filament was still brightly visible in a darkened room when the

current as indicated by the ammeter was reduced to .05 ampere. If the lamp were dimmed to the same incandescence by means of dead resistance the current required would be .15 ampere or three times as great.

There are many positions where it is desirable to reduce the illumination to the lowest degree, leaving the filament only bright enough to mark the position of the lamp when it is desired to turn on the light. Under such circumstances it is of some consequence to be able to dim the lamp by means of an apparatus that will not itself consume more energy than the lamp. My experiments showed that this can be successfully accomplished by means of the vibrating contact breaker.

SELECTION OF STEAM-ENGINES FOR ELECTRIC LIGHTING PLANTS.

BY

Francis B. Crocker

The selection of the best size and type of steam-engine for a given electric lighting plant is, next to the selection of the system itself, the most important question which the engineer has to decide, since the satisfactory operation and working expenses of the station are directly dependent upon it.

The number of units in large central stations, whether steam-engines or dynamos, should be sufficient so that the disabling of one will not interfere with the proper running of the station; and it is preferable that the number and size of units should be such that two of them may break down, and still allow the plant to carry its full load. The same idea may be expressed somewhat differently by stating that no unit should be more than one-quarter to one-tenth of the total capacity of the plant, and there should be one or two spare machines. In very small plants it is obviously impracticable to subdivide the power into many units, but, it is desirable to have at least two engines; each of which is capable of carrying the ordinary load, or such a large fraction of it, that enough lights can be run to give a reasonable supply, in case of a stoppage of one engine. In central stations of medium size the number of engines should be intermediate between those of a large station and a small plant, that is, from 3 to 6. There are exceptions to these general rules, some stations being run by one or two very large engines connected to a few large dynamos, or to a number of small ones. This plan has the advantage of simplicity and low first cost; but it has the disadvantages of practically shutting down the station if anything happens to one engine, and the economy of running a large engine during periods of light load would be very low. In fact, one or two auxiliary engines of smaller size would be a very desirable addition to such a plant, not only as a safeguard in case of a breakdown of the main engine, but also for use when the load is small. Hence the total number of engines would be about three or four.

The relative size of the units, that is, the question whether they should be of the same or of different power, is often a perplexing point. The chief advantage of uniformity in size is the interchangeability of parts, and the possibility of having one or two spare parts which can be used in any engine which may happen to require them. On the other hand, the adoption of engines of different sizes may result in greater convenience and increased all-day efficiency of the plant; for example, in an isolated plant with which the writer is familiar, there is one engine and dynamo of 750 lights capacity, and one of 250 lights, giving a total capacity of 1,000 lights. During the day and late at night the smaller engine can be run very economically with the load, which varies between 100 and and 200 lights. When the load increases at the approach of darkness, the larger engine is substituted for the smaller, and supplies power for the 500 to 700 lights which are used during the evening. In this way each engine is almost perfectly suited to its load for long periods of time, the interval between the light load of the day and the heavy load of the evening being so short that the larger engine has to run for only a few minutes at an uneconomically light load; and for an unusually large load both engines can be run at the same time. In the design of central stations a similar judicious selection of engines may give excellent results. For instance, large compound or triple expansion engines may be operated almost continually to carry the permanent portion of the load with high economy, but for the maximum load which usually lasts only an hour or two, simpler and cheaper engines may be used.

A little ingenuity and judgment will suggest many other similar plans by which convenience and efficiency can be secured. Careful adaptation of the size, number and type of the engines will largely overcome the serious drawback of low economy in electric-lighting plants, which arises from operating steam engines with light loads and variable loads. In nearly every case it would be possible to so select the engines that at no time would any one or more of them be running below 60 or above 125 per cent. of its normal load. The latter limit is perfectly allowable, as will be shown later, and avoids the very low efficiency which results from running an engine at a small fraction of its full power. This arrangement might not be possible where the variations in load are very sudden, as they are in electric railway work, but in electric lighting the changes are usually quite gradual, and almost always allow sufficient time to put on or take off engines. Such schemes accomplish practically the same result as the use of storage batteries in enabling the engines always to be run at high efficiency, and would avoid the complication of the former and the loss of energy which occurs in charging and discharging them. In some cases the carrying out of this idea might be difficult, either because the load is continually varying throughout the entire twenty-four hours of the day, or because the number of lamps connected to the station might increase so that a proper proportion in the size of engines in the beginning might not be right a few months afterwards; and the conditions would also change greatly with the season of the year. This, however, could be foreseen more or less, and could be provided for in originally planning or increasing the capacity of the plant.

In general, it may be stated that in central stations or large isolated plants it may be desirable, or at least allowable, to have two sizes of engines. But more than this are objectionable. Many plants are in the unfortunate position of having installed several different sizes and types of engines at various periods of their history, corresponding to the conditions existing at each time. In many cases this cannot be helped; but often a little foresight will save a plant from becoming a museum, which represents by numerous examples the progress of steam and electrical engineering.

The type selected is largely determined by the size, small engines being usually simple, and large ones compound or triple expansion. Similarly, small engines may be high speed, and large engines should be low or medium speed. If floor space is limited, a vertical engine may be chosen. The question of the relative merits of direct coupling, belting, and other forms of connection between engine and dynamo is one of the first which must be decided.

Direct-coupling is the simplest, and for that reason the most desirable arrangement, provided it can be adopted without involving sacrifices which offset its advantages. For example, the engine and dynamo must run at the same speed, but unfortunately they do not naturally agree in this respect. It is perfectly practicable to run dynamos at 500 to 1000 revolutions per minute.

The speed of a steam-engine, on the contrary, is naturally and properly quite low; and even a high-speed

steam-engine cannot be run much above 300 revolutions per minute advantageously and a speed of 75 to 100 revolutions per minute is a much better limit for engines of any considerable size. The large Corliss engines used in electric lighting with such excellent results run at about 60 to 125 revolutions per minute. Thus we see that it is necessary either to raise the speed of the engine above the point at which it works well, or reduce the speed of the dynamo below that at which it gives its full capacity, in order to make the two coincide, and permit them to be directly coupled. As a matter of fact, one or both of these modifications in speed are made in almost all cases of direct coupling, and the engine is run higher, or the dynamo run lower, in speed than would be the case if the two machines were to operate independently. The running of an engine above a certain speed is decidedly objectionable, since it reduces its efficiency, requires more attention, increases the wear and repairs, and consumes more oil. Any one who has ever had experience in running engines at 80 revolutions per minute, and also at 350 revolutions per minute, realizes the enormous difference between the two cases in what might be called the *comfortable*, as well as the economical, working of the plant. In fact, any increase in speed of an engine, even if it is only 10 per cent. above that at which it runs, normally, will begin to make perceptible differences in its working.

The speed of a dynamo, on the other hand, can be brought down without much reduction in efficiency or other disadvantage, except that the output is decreased, or, what is the same thing, the size and weight are increased for a given output. It is a common thing to hear persons attempt to get around this fact, and confuse or deceive themselves by assuming some form of winding or other arrangement which will give the same output at a lower speed; but we know that a dynamo running at 250 revolutions per minute will give almost exactly twice the output if the speed be increased to 500 revolutions per minute, and in many cases there would be no reason why the higher speed would be objectionable. In other words, it is run at a low speed and has a diminished output simply to allow it to be directly coupled to the engine. It may be a proper, or even a very desirable, thing to design dynamos to work at low speed, but the engineer should fully realize that it usually involves some sacrifices of material output and efficiency in the machine itself. The usual way to construct a low-speed dynamo is to make the armature of large diameter, thus securing a sufficiently high peripheral velocity; at the same time the armature core is made in the form of a ring, with a comparatively small radial thickness, in order to reduce the weight of iron required. Nevertheless, the frame, shaft, bearings, and other parts of such a machine are necessarily heavier and more costly than if the armature were of smaller diameter and higher speed. The compactness, simplicity, noiselessness and general advantages of direct coupling are so great, however, that they will often fully warrant the extra cost, and in some cases it may be almost a necessity, as, for example, in the case of a dynamo for use on shipboard, or for other plants in which the space is limited.

Belt-connection has the following advantages:—

1. It enables almost any desired ratio of speed to be obtained in a convenient and simple manner.
2. It is cheap.
3. It is applicable to almost any case, provided the space be sufficient.
4. The machines are almost entirely independent, so that either the engine or dynamo, or both, can be changed, repaired, or operated without interfering with each other.
5. The dynamo is perfectly insulated so far as the belting is concerned, since the latter is almost always made of non-conducting material.

The general disadvantages of belting are:—

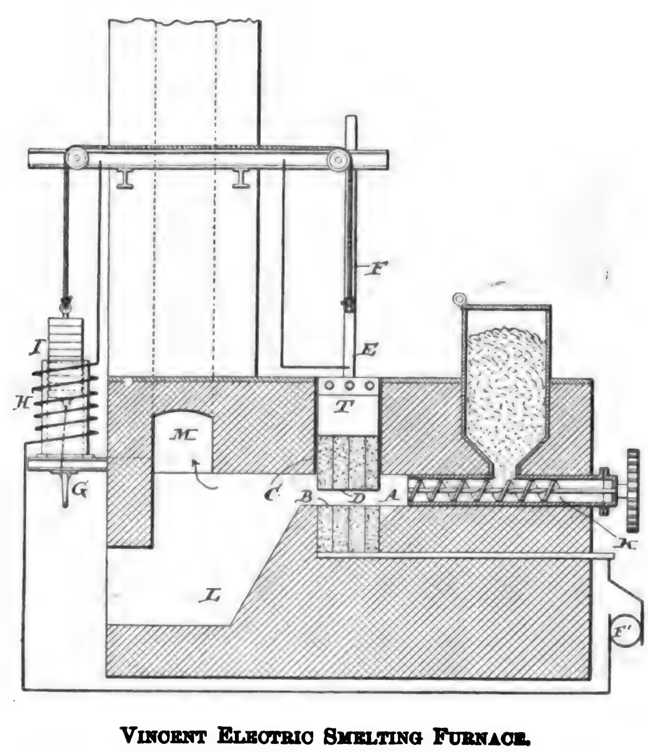
1. It requires considerable space, since the machines must be placed a certain distance apart in order to make the belt work properly.
2. The action is not positive, there being a certain slip even in normal working, and in case of an over load or other trouble the belt may run off the pulleys, or break.
3. Belting sometimes causes unsteadiness in speed owing to its slipping or flapping on the pulleys, which may produce flickering of the lights.
4. For the same reasons it may give out noise.
5. Belts exert a side pull on the bearings which causes friction and wear.

The last difficulty can be largely overcome by proper design and attention. Dynamos have been run for years with very little wear in the bearings. The loss of power is also smaller than is often supposed. In fact, belt-connected dynamos have a higher efficiency at light loads, because there is less material than in direct-coupled machines, to cause frictional and magnetic losses.

The proper size, number, and type of dynamos to select is not so important as in the case of engines, for the reason that dynamos can be run at one-half or even one-quarter of their full load without seriously impairing their efficiency. It is also a fact that a dynamo can be started and stopped much more quickly and easily than a steam-engine, and without the loss of energy involved in heating up the latter. Furthermore, a dynamo can be run free with only 5 per cent. of its full power even when the field-magnet is excited, and with about 3 per cent. if the field is not excited, whereas a steam-engine requires 8 to 12 per cent. of its full power to run free; hence there is much greater likelihood of mistake or loss in the selecting or handling of steam engines.

VINCENT'S CONTINUOUS ELECTRIC SMELTING FURNACE.

Electric smelting processes as now generally carried on are discontinuous in their nature; that is to say, the furnace is charged with a given amount of mineral to be reduced or converted and when the process is complete the furnace is emptied and a new charge inserted. This method of working usually puts the furnace out of actual operation for some time, so far as actual smelting is concerned and to that extent entails a loss of time. To effect a desired economy in this respect, Mr. J. A. Vincent, of Philadelphia, Pa., has designed an electric furnace in which all the operations are continuous.



VINCENT ELECTRIC SMELTING FURNACE.

The manner of operation of the Vincent furnace will be

readily understood by an inspection of the accompanying engraving which shows it in section. Here A is a horizontal channel-way having a bed B of carbon, which is stationary and acts as one of the electrodes.

C is a vertical opening extending into the channel-way, and in this is arranged the other electrode D, consisting of rectangular carbon-blocks held in a metal clamp T, which is raised and lowered by a rod E, ropes and windlass G. As the carbon D is consumed, the electrode is bodily lowered, so as to approximately keep the two electrodes at the same or uniform distance apart to maintain an arc consuming substantially a constant current and voltage.

As it is more desirable to make the feeding of the movable or positive electrode automatic, this is accomplished by providing a solenoid H in series with the electrodes, in which a magnetic core I moves. This core is connected to the ropes F and by them raises or lowers the electrode D in accordance with the requirements. When this electrode-regulator is used, the connection with the windlass G is only used in setting the electrode in position. It is desirable that the clamp T substantially close the vertical opening C, so that little or no air can enter to abnormally consume the carbon of the electrodes.

The ore or material to be treated is finely pulverized and placed in a hopper J, from which it is received by the feeding-screw K, which forces it into the channel-way between the electrodes. As the smelted product is formed, the incoming unsmelted material forces it into the pit L, where it is collected and kept in a hot atmosphere until ready to be removed.

The stack M is provided for the escape of gases generated by the smelting operation and opens laterally from the channel-way at its discharge end, it being desirable to have the channel-way continuous and uniform in cross-section throughout its length, especially where it receives the electrodes B and D.

The furnace is specially adapted to the production of calcium carbide.

THE RUSSELL-SEE ELECTRIC INDICATOR.

THE apparatus illustrated by the accompanying engravings consists of a simple electric indicating and controlling mechanism which, when applied to a vessel, will at all times keep the pilot informed of the condition of his running lights. The information is conveyed by both visible and audible indications produced in the pilot house or other convenient place, so that when a lamp hap-

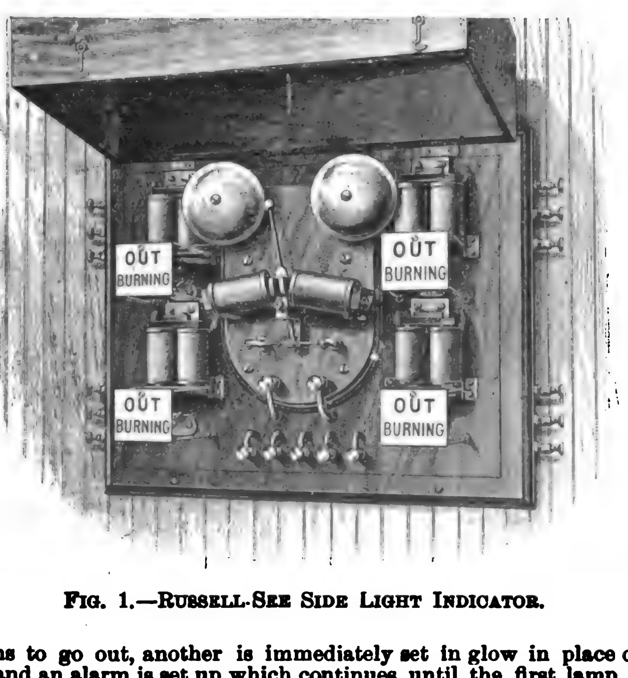
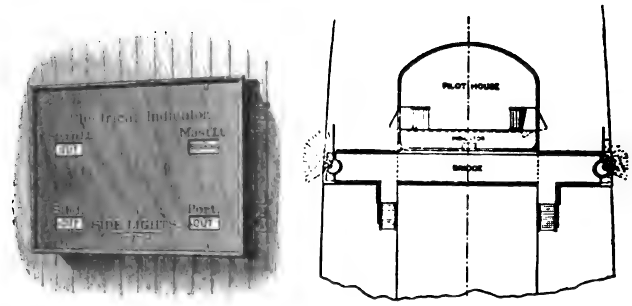


FIG. 1.—RUSSELL-SEE SIDE LIGHT INDICATOR.

pens to go out, another is immediately set in glow in place of it and an alarm is set up which continues until the first lamp is restored. Thus one lamp is always in reserve.

In the engraving, Fig. 1, the cover is raised to show the general arrangement of the operating parts; in Fig. 2 the cover is lowered, and the indicating shutters appear at the four slots; Fig. 3 is a plan view showing the relative positions of the running lights, the bridge, pilot house and indicator. It will be observed that, as illustrated in Figs. 1 and 2, the device is adapted for indicating four sets of lights, while the diagram shows the location of only two. The lights are connected in circuit with the alarm and indicating apparatus, the arrangement, however, being such that only one of each pair of lights is normally in operation, and these constitute, therefore, the regular running lights. The other lights are what are called "preventor lights," that is to say, they come into glow only when the regular lights happen to become



FIGS. 2 AND 3.—RUSSELL-SEE SIDE LIGHT INDICATOR.

extinguished. At the same time the shutter moves in front of the opening which is visible to the pilot, and the bell sounds, giving the alarm.

Within the indicator are four electro-magnets, the armatures of which are provided with retracting springs connected to a fixed abutment in the usual way. The armatures carry rods at the outer ends of which are shutters, each of which bears the words "Burning" and "Out." These shutters appear behind the openings in front of the case, these openings being of such size as to permit only one word to be seen at a time. In addition to these four magnets governing the movement of the shutters, there is a fifth magnet whose armature is arranged to ring the gongs and thereby provide the audible signal.

When in normal operation the current passes through one of the pair of lights—say the starboard—thence through the electro-magnet connected in circuit with it. The magnet is thus energized and its armature attracted to display the word "Burning" at the starboard opening of the indicator.

Now let it be supposed that this lamp burns out, so that the starboard main lamp circuit is broken at the lamp. This throws into operation what is called the "starboard bell circuit." As the magnet has become de-energized, its armature drops and the word "Out" is brought into view at the opening. This movement of the armature establishes an electrical connection with the gong magnets and the alarm is sounded. The armature carrying the striker is so designed that it is impossible for it to come to rest in the midway position. The construction is such that the vibration of the hammer is accomplished without even breaking the circuit in which the bell mechanism is located. The current which now passes through the bell mechanism lights the second or preventor lamp of the starboard pair. This lamp continues to glow until the broken lamp has been replaced.

While the device has been successfully applied to several steamers, it may be employed for a wide variety of purposes. Thus, it may be used to insure the operation of any electrical apparatus wherein a rupture of the circuit is likely to be attended with serious results; or it may be used to give warning of the failure of railroad signal mechanism to act and to replace at once the inoperative contrivance by another and operative one. It will also indicate at a distant station that the lamps in a subway or tunnel are not working and substitute others for them. The indicator has been designed by Horace See, of New York. We are indebted to the *Iron Age* for the accompanying illustrations.

MUNICIPAL LIGHTING A FAILURE AT BRAINERD, MINN.

The Brainerd (Minn.) newspapers publish a notice of a special election to be held in that city on Dec. 17th to vote on the question of the city's selling its electric light plant to private parties. It is all the more remarkable as Brainerd has a fine water power, and the city has paid nothing for the use of the power to run its dynamos. The report of the special committee of the common council on this subject says:—

We respectfully recommend that the question of the sale of the plant be submitted to a vote of the electors of this city. The proposition meets with our approval. Our reasons are as follows:

"First.—The city will receive much more for the plant than it is really worth, and at the same time be relieved of a large indebtedness. (The city assumed $40,000 of bonds on buying the

plant, and issued $20,000 more for improvements. The proposition to sell is for the parties buying to assume and pay these bonds, i. e., $60,000. So if they are selling for more than the plant is really worth they must have paid too much for it in the first instance.)

"Second.—If the plant is not sold the city must in a short time expend large sums of money to make it serviceable.

"Third.—The ownership of the plant by the city has not proven profitable to the city, and without criticising anybody, we must say the service has been poor and not entirely satisfactory.

"Fourth.—We may be reasonably certain that we shall get better service if the plant is sold.

"Fifth.—It has been the policy of this city, as well as of all progressive cities, to encourage capital within reasonable bounds, and those who are willing to employ it in building up such industries as will be beneficial to the communities in which they operate, and by transferring this plant to the said company we are of the opinion that the city will not only get rid of this large indebtedness, but will also show that we as a community are willing to extend a helping hand to those who are trying to build up our city.

THE THOMPSON-RYAN DYNAMO.

OUR readers will recall the paper read last Spring by Prof. Harris J. Ryan, before the American Institute of Electrical Engineers. In this paper the author described a type of machine having a special method of field winding which resulted in a practical balancing of armature reaction and consequent removal of its ill effects on regulation and output of the machine. This machine further improved by Mr. M. E. Thompson and known as the Thompson-Ryan dynamo is now being manufactured by the J. H. McEwen Mfg. Co., of 26 Cortlandt street, New York, the works being situated at Ridgway, Pa.

The most important feature of the machine is a set of series windings surrounding the armature, and termed balancing coils. At first thought it would seem that the addition of balancing coils to a dynamo would complicate the construction to a certain extent, and so it would if applied to the ordinary type. But all this is fully offset by the simplification of the machine in other respects. The field castings of these machines are of steel and consist of but three pieces which are held together by four bolts. One of these castings is the "pole-ring," shown in Fig. 5, through which the balancing coils are wound, and the other two constitute the field ring proper, Fig. 7.

The balancing coils are wound in such a way that the current passes through them across the pole face in the opposite direction from currents in the armature conductors, and thus the magnetic effects of the armature currents are neutralized.

Fig. 6 is a view of the completed pole ring. The field ring, Fig. 7, shows on its internal periphery the "pole necks," around which the coils are placed. It will be seen that the field ring is of such a shape as to entirely enclose the field coils, thus thoroughly protecting them from mechanical injury. It will be noted also that the space in the field ring allowed for the field coils is unusually small. This arises from the fact that less than one-fourth as much energy is required to magnetize the fields of this dynamo as is necessary for a machine of equal capacity of ordinary design. On account of the very small amount of field energy required the rise in temperature of the field coils is very slight, notwithstanding the fact that these coils are so nearly surrounded on all sides. No compound winding is used on these dynamos, since the balancing coils afford a compounding much more effective than the compound coils of the ordinary dynamo.

All of the armatures for the Thompson-Ryan dynamos, of whatever capacity and whether wire wound or bar wound, are constructed on the same general style. The cores are built of thin plates of a peculiar, special steel, the distinctive feature of which is its unusually low hysteresis loss. The plates are stamped out in the form of rings, and a series of long slots are punched near the edges. These rings are then clamped firmly to a central hub or spider by means of brass end plates. There are no bolts passing through the laminated core, and no iron comes in contact with these plates. As a consequence of this there is no leakage of magnetism and no development of potential in any part of the core to cause eddy currents and waste energy. The holes in the plates form "tunnels" in which the armature windings are placed. Fig. 8 gives a very good idea of the appearance of the finished armature core.

Another peculiarity of this machine is the large number of poles used. This feature, which in ordinary designs would be bad practice, is a valuable one of this peculiar style of design, enabling the builders to greatly shorten their armature conductors, and to use on all their armatures what may be described as the cylindro-hexagonal style of drum winding. In this winding, all parts of every conductor of any particular layer on the armature lie in the same cylindrical surface, and the windings do not bend down over the end of the armature core at any point, and the conductors being placed through the core and below the surface, no binding wire is necessary.

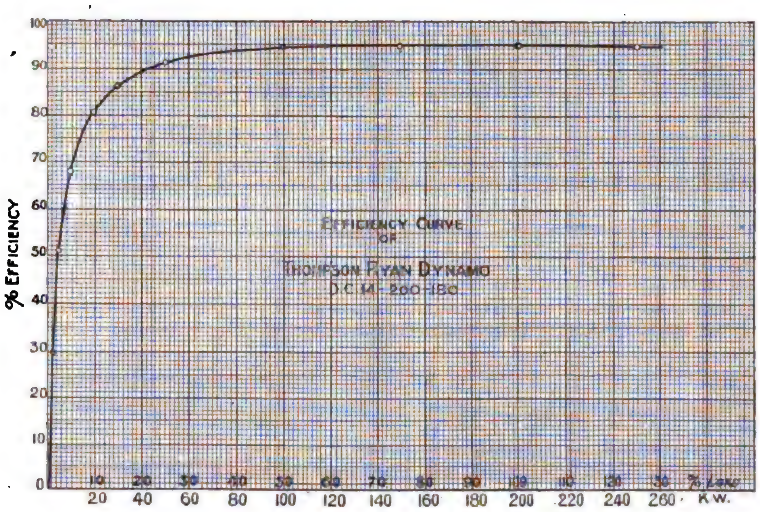
The commutators are carefully built, and, as a rule, are large in diameter and comparatively short in length. They are not mounted on the shaft as is the usual practice, but are carried by a projecting ring of the spider. Fig. 9 is a view of the completed armature for a 200 K. W. direct connected railway generator.

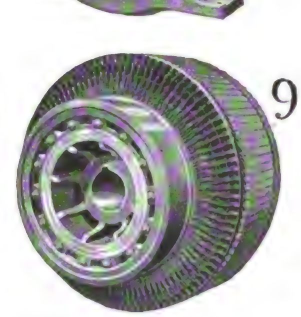
One of the most important and noticeable features of these armatures is the ventilation. The armature being large in diameter the central opening is also large and extends entirely through the armature from end to end, thus affording large heat radiating surface. The principal ventilation is effected by the winding itself. The conductors cross one another in such a way as to form a sort of open lattice work with innumerable radial openings through which the air circulates in great quantities.

Fig. 10 is a view of the complete brush holder arrangement. The brush holders project outward, and leave the entire outer end of the commutator free and accessible.

The brush holders themselves are very simple, and hold the brushes in such a way that they require no adjustment, but have only to be slipped into the holder. Working with brush holders absolutely fixed, there is entire freedom from sparking under any and all conditions of load.

The whole brush holder arrangement is adjustable around the commutator, and by loosening the clamp bolts, the brushes may be shifted backward or forward. This is only done, however, for





DETAILS OF THOMPSON-RYAN DYNAMO AND CURVE OF EFFICIENCY.

the purpose of adjusting the compounding of the machine. By shifting the brushes in this way the machines may be adjusted through a range of from 10 per cent. drop at full load to 10 per cent. rise, and this without any effect whatever on the commutation.

The engraving also shows a curve of commercial efficiency taken from actual tests of a Thompson-Ryan 200 K. W. railway generator. The peculiar features of this curve are not so much the good efficiency under heavy load, as the unusually high efficiency under light loads and the very great range of uniform efficiency. This is due to the unusually small fixed losses, the result of the very small field energy consumed and the light core losses.

Another important feature of this dynamo is the great ease with which two or more machines may be worked in parallel. The design of the machine peculiarly fits it for this sort of service. They may be thrown in parallel while differing widely in voltage produced, and each machine will take its due proportion of the load, notwithstanding the fact that they may be greatly over compounded. Two or more of these machines will work perfectly in parallel, and divide the lightest load evenly or maintain perfect unison with the entire load thrown off.

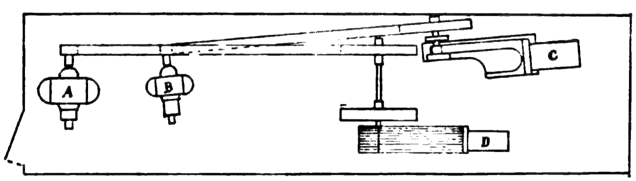
The Thompson-Ryan dynamos are built in sizes from 12½ K. W. to 1500 K. W. capacity both belted and direct connected.

A NOVEL BELT DRIVEN LIGHTING PLANT.

THE Hotel Normandie, at Washington, contains a lighting plant which is peculiar for its accomplishing in a rather simple way what is generally done by means of a countershaft with clutch pulleys.

Referring to the accompanying diagram, A is a 600-light National dynamo belted to a 9½ x 12 Beck engine, D. B is a 250-light Belknap dynamo run usually by Buckeye engine C.

The pulley of dynamo B is placed between the upper and lower



A NOVEL BELT DRIVEN LIGHTING PLANT.

parts of the belt to A, so that by slightly twisting B it can be run by engine D. D can thus run A and B simultaneously. It is also possible to adjust A so as to be run by C. This arrangement is due to W. T. Stuart, the engineer of the hotel.

Of course it is to be understood that belts are kept on hand ready to make these changes, also the dynamo base frames are not bolted to the foundations but are held in place by the weight of the machines.

BLEEDING THE PEOPLE'S CO. OF TRENTON, N. J.

A special dispatch of Dec. 12 from Trenton, N. J., says:—The General Electric Company, of New York, is trying to make ex-Mayor Frank Magowan of this city, give up $75,000 of $160,000 he made by a little scheme. Frank Z. Maguire is a co-defendant. Arguments in the action were heard by Vice-Chancellor Bird to-day. The contracts for the electric lighting in Trenton were about to expire in 1892, when Magowan organized the Edison Light and Power Company, with himself, Maguire and William P. Hayes as stockholders. Only about $500 was spent in the enterprise.

Magowan succeeded in getting franchises that so frightened the People's Electric Light and Power Company, which had the contract from the city, that it paid him $150,000 for the franchises and $10,000 for organizing his company.

The General Electric Company alleges that Maguire was acting as its agent in dealing with Magowan and that it is entitled to one-half of the $150,000.

FROM A CALIFORNIA CENTRAL STATION.

"Enclosed you will find $3, for which please renew my subscription to your most excellent paper. In this connection I will tell you a little incident, which speaks for itself. Last spring when I became a subscriber to THE ELECTRICAL ENGINEER, I had as an assistant a young man who thought the only paper worth taking was the ——. After the ENGINEER had been in the station a few weeks, he turned to me one evening and said: 'The ENGINEER beats the —— all hollow.'"

"The only trouble I have been able to find with the Data Sheets is that they don't appear often enough."—Geo. F. Steele.

LOSS OF REVENUE DUE TO TRANSFORMER LEAKAGE CURRENT.

BY SPRING S. ARMSTRONG.

Alternating current, as applied to electric lighting, has become nearly universal, and in a great measure the general excellence and efficiency of apparatus has kept pace with the increased demand, but, particularly in smaller central stations, it is a well-known and regrettable fact that too little attention has been given to transformers. It is a broad claim, but nevertheless a true one, that the transformer system of any alternating current station is the keystone of the arch on which profit and ultimate success are to be erected.

In view of the many strictly impartial laboratory and service tests made of the various transformers offered on the market, it is fair and reasonable to assume that two-thirds are a positive detriment to any plant, and that the sole reason for their existence lies in the ignorance of careless managers who accept claims made by manufacturers in blind confidence and without corroborative tests. It is unnecessary to explain that low first cost is the lever by which these inferior transformers have found their way to the confidence of central stations; and it is also worthy of note that the really good article, the distinctly earning factor purchased and installed by the larger and more intelligent plants, is always sold at a higher price than its unworthy brother.

There are transformers sold to-day in the open market at less than the actual shop cost of a high grade converter, and yet they are eagerly bought because they are "cheap," with careless indifference as to their future economy.

There are hundreds of plants throughout the country whose lines are crowded with small units of these "cheap" converters, each later purchase being a little "cheaper" than its predecessor, both in quality and in price. And yet the owners complain of their unprofitable investment, but, nevertheless, they would not for a moment consider the expediency of "scrapping" these transformers and re-fitting their lines with economical devices, even though the change would result in a large increase of revenue.

From complete and impartial tests of all existing transformers in 1,000 watt sizes, it is seen that in more than two-thirds of different makes the leakage of current alone at no load is from 5 to 10% of the entire capacity of the converter, while in the remaining one-third it varies from 2½ to 4½%. Taking the difference in extremes, a net loss of 75 watts may be charged to the account of the "cheap" transformer, from which the central station derives absolutely no revenue. Now, admitting that the small stations will run on an average of eight hours per day, we have as a formula of dead loss the following: $75 \times 8 \times 365 = 219{,}000$ watt hours constant loss per year on each and every one of these "cheap" 20 light converters. It is fair to assume that 60 watt 16 C. P. incandescent lamps will represent the average efficiency of lamps in use, for which ½ct. per lamp-hour is charged; hence, we have $75 \times 8 \times 365 \div 60 \times \frac{1}{2} =$ $27.38 actual loss in revenue on *each* 20 light "cheap" transformer, or about 10% more than the first cost of the best of the high grade converters.

In a plant furnishing one thousand lights and employing on an average 20 light units of these inferior transformers, the loss of earning power due to leakage alone is $550.00, or 5% interest on $11,000.00. But it may be argued that this is not a fair estimate of the earning capacity of each transformer due to the fact that all of this leakage would not be regularly paid for. This is very true, but we can only arrive at a just comparison by assuming this to be the case, for whether all of this loss by leakage is paid for or not, the conclusion holds good in the case of both the inferior transformer as well as the high grade one. However, judged alone by the coal pile, it is demonstrated that two tons of good coal per 1000 watt converter are consumed annually to supply current for which not one penny is returned; i. e., $5.00 or $6.00 annually, according to location of plant and price of coal, are required to pay the difference in leakage alone between the two types of transformers cited. This waste becomes more serious as plants increase in capacity, for it is unfortunately a fact that many stations with an output of several thousand lamps are using these inferior transformers by reason of their low first cost.

Now let us consider this matter of first cost. A 1000 watt converter (L) may be purchased in the open market for $18.00. Another manufacturer (A) demands $25.00, but L has a leakage of 100 watts, while A has only 25; hence to tabulate:

Type.	First Cost.	Annual Leakage in amp. hours.	Annual loss at ½c. per lamp hour.	Total cost at end of year.
L....	$18 00	4867	$36.51	$54 51
A.....	25.00	1217	9.12	34.12

Therefore, A is honestly the cheaper of the two transformers owing to lack of earning power of L by $20.39.

This is not intended as an exhaustive treatise on transformers; therefore, avoiding comparisons that are not elements of constant

loss, we will give only the demonstrated leakage on the *various makes of converters as given in a recent reliable test:*

LEAKAGE ON OPEN SECONDARY IN WATTS.

A	B	C	D	E	F	G	H	I	J	K	L
24	34	42	43	48	51	60	61	77	84	89	108

All the manufacturers of transformers claim to have the "best," and as this is in the ordinary course of business, such claims are to be expected; but the central station manager is misguided and in error to blindly accept claims for facts and allow a few dollars in first cost to jeopardize the success of his plant under the grave delusion that one transformer is as good as another.

Many of the large and intelligently conducted stations are taking inferior converters from their lines, and deliberately selling them for junk, replacing them with the best transformers obtainable, and this only after a severe test of merit. With these stations it is noticeable that first cost plays but a minor part in selection, and is considered only where every thing else is equal; it is the economy and revenue-producing qualities that are sought for and purchased.

Equal care and intelligence will produce equal results in the small station, and if every manager will "scrap" *all* his leaky, cheap transformers, and purchase only a high grade article, he will make a saving the first year, even though he does not realize a dollar from the sale of his old converters. Furthermore, all manufacturers' claims should be set aside, and each transformer purchased should be thoroughly tested. For this purpose elaborate and expensive instruments are not necessarily required, fair results being obtainable otherwise. As bearing upon this subject, we quote from the admirable article "The Choice of Transformers," by Prof. D. C. Jackson, which appeared in the issue of THE ELECTRICAL ENGINEER, Aug. 21, 1895:

To test the iron losses, the secondary coil of a transformer should be connected to the regular lighting circuit, with an ordinary wattmeter included, and the circuit of the primary coil should be left open. The reading of the wattmeter shows the number of watts which are wasted by the iron loss. A watt meter such as is required for these measurements, costs from \$40.00 to \$70.00, and is an instrument that, like the steam engine indicator, pays to have at hand for proper use. However, if the regular wattmeter is too expensive to buy, an ordinary Thomson recording wattmeter, provided a sufficiently sensitive and reliable one is at hand, may be used in place of it, and the record reduced to the basis of one hour. It is needless to say that instruments which are used in such tests as are here proposed must be fairly reliable. * * * * * For guidance in selecting transformers, I will give the following data. * * * * * The table gives the largest currents which should flow in the 1,000 volt primary of good transformers when the secondary circuits are open:

WATTS CAPACITY.	LEAKAGE CURRENT.
1,000	.055
2,000	.080
6,500	.100
17,500	.200

* * * * * For intermediate capacities, intermediate values of the open circuit or leakage current may be expected. I shall add to this the values of the iron loss, which should not be exceeded in thoroughly good transformers:

WATTS CAPACITY.	IRON LOSS.
1,000	30
1,500	40
2,000	50
2,500	60
4,000	80
6,500	100
17,500	150

A careful perusal of Prof. Jackson's article in its entirety will amply repay any central station manager who is desirous of effecting a saving in his plant and to determine the relative points of economy in his transformer system.

A very material saving may be obtained by the use of as large units in transformers as existing conditions will permit of. In small plants it is often observed that each residence is furnished with an individual converter, and later on, as customers are added in the same block, more small transformers are put in service, until in a block of say, ten houses, there will be seen as many small converters, giving 50 volts on the secondary, in use, one to each residence. Now, assuming that these ten houses use in the aggregate one hundred lights, great economy would result by removing the small units, and substituting say, a 75 light transformer in some central location, and feeding into the various houses with 100 volts on the secondary.

In installing a 75 light transformer instead of a 100 light unit, it is justly assumed that all of the lights would not be in service simultaneously. Even should such an event occur, however, there would be no danger of a burn-out, as any high grade converter is guaranteed to safely carry an overload of from 25 to 50% of its rated capacity.

In making the changes suggested, the small units may be used advantageously in remote districts where there are not sufficient customers to justify for a time the installing of a large transformer. The gain effected by the proposed alteration would be about as follows:

First cost of ten 10 lighters (est.)	\$150.00	
" " " installing "	25.00	
Loss in leakage per year	91.00	
		\$266.00
First cost of one 75 lighter (est.)	\$65.00	
" " " installing "	10.00	
Loss in leakage per year	26 00	
		\$101.00
Economy effected per year by using large unit		165.00

If managers will write to any of the manufacturers of reliable transformers, giving the conditions of their plant, and information as to where large converters may be substituted for several small ones, they will be furnished all data of savings that may be effected thereby. As a move in the direction of economy, *use the largest transformers possible in your service.*

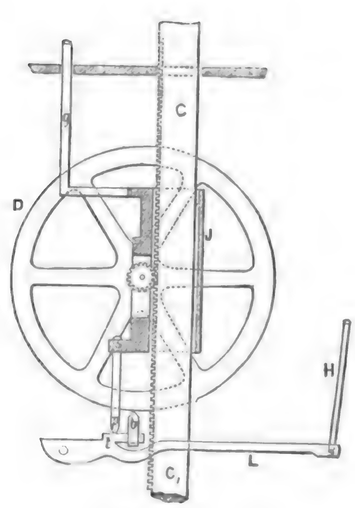
While we have here touched upon only one of the many existing station losses and ventured upon suggesting a simple remedy, it may well be questioned whether our plant manager, to be consistent in all things, would not carry his inconsistencies so far as to purchase cheap boilers, engines, dynamos and lamps, buying all with no thought of future economy and for no other reason than that they were to be obtained at less cost than others in the market. To remedy existing transformer losses, will, however, go far in the right direction and lead the way to such systematic overhaulings as may be necessary to put a small station on a solid base of profit.

This has not been written in behalf of any particular make of transformer, but is intended as a special plea to managers of alternating current plants, to look beyond the immediate future for economies to be effected and consequent profits to follow. Plants which are operating lucratively are an attractive and effective inducement for further investment of capital, thereby benefiting electrical industries as a whole.

THE CROMPTON ARC LAMP.

IN one of his recent Cantor Lectures on "The Arc Light," reported in the *Journal of the Society of Arts*, Prof. S. P. Thompson describes a number of English lamp mechanisms, among them the Crompton lamp, which is much employed in England. The principle upon which the lamps work will be understood from the accompanying engraving.

On the carbon rod is cut a rack, which drives a brake-wheel, or rather a pair of brake-wheels, one behind the other, on the same pinion. The arbor bearing is not fixed in the frame of the lamp,



CROMPTON ARC LAMP.

but passes through a short sleeve or jockey, which, when the wheel is free to turn, can slide up or down the carbon rod, but is prevented from turning sideways by the guide pin, *g*, above. Below the brake-wheel is a lever, L, pivoted at *o*, and attached by a link, H, to the core of the solenoid overhead. This lever carries a small table, *t*, and brake-piece, *b*, faced with phosphor bronze. When the lamp is out of action, the free end of the lever is down,

and the weight of the wheels and the carbon holder bears down upon the table, *t*, by means of the pin, *p*, which projects from the jockey-sleeve. In this position the wheels do not touch the brake piece, *b*, and are free to rotate so that the carbon rod is free and the carbons are together. When the current is turned on, the main current coil attracts its core, first drawing up the lever, which, turning on its pivot as it rises, brings the brake-piece against the rim of the brake-wheels and prevents them from rotating. Any further rise of the lever lifts the brake-wheel jockey and carbon holder, thus striking the arc. As the arc burns away and the shunt coil comes into action, the lever descends slowly feeding the arc as required, and before it gets to the end of its tether the brake-wheels are released, and feeding takes place by the release of the carbon rod, the inertia of the wheels preventing any jerky motion.

THE LUMINOSITY LIMIT OF THE HYDRO-CARBON FLAMES.—II.

(*Concluded.*)

BY DR. W. H. BIRCHMORE.

The same results obtained in the experiment mentioned at the end of the preceding article may be had by performing one or both of the following experiments:

(*a.*) Heat a few grammes of coal tar slowly in a porcelain crucible; results much as follows will ensue. The black solid melts, heavy smoke rises; if the heat be increased, a dull red flame will appear close to the edge of the crucible, but it will be only a few millimetres high; the top of the smoke column may also be tipped with flame. If the heating is continued a brighter and yet brighter flame appears until that peculiar brilliancy is reached that is typical of an election night bonfire.

The change that takes place in the first place is simply a re-arrangement of the complex molecules with the precipitation of the carbon; these are multatomic, and of slight cohesion, and their breaking point is the lowest known among the whole range of such compounds. The red flame appears when the heat is sufficient to fire the hydrogen that is freed; none of the carbon that is liberated seems to get hot enough to burn, and all that makes the "red flame" is the heated carbon of the broken molecules; the top flame is produced by hydro-carbons of a higher breaking temperature which were carried up inside the smoke column, it is the presence of these which makes the smoke banner of fires so dangerous to the surrounding buildings. In the next stage the heat is sufficient to burn some of the carbon, and from this on the heat rises, but at no time does the fire get so hot as to break anything like all the inter-atomic bands. (See later experimnts with over-carburetted illuminating gas.) (*b.*) Place a Rose's crucible, containing a few grammes of "Utah non-coking coal," mixed with a few grammes of "Utah coking lignite," within another of a coarser texture, fill the space between them with sand, lute in the tube, put on the cover, and heat. It is well to dry the coal thoroughly beforehand so as to be sure that it contains no free water. Heat the crucible slowly and a stream of watery vapor, with carbon in suspension, will issue. If a match be presented it will not fire; but presently it will, showing that it contains not carbon alone but in combination. Finally, if the heat is raised, a point is reached when the gas ignites on reaching the air, and burns with a brighter and brighter flame as the temperature of the crucible rises. If the changes have been carefully watched with a spectroscope the spreading of the light from a dull red toward the orange and then into the yellow until the entire spectrum is brilliant, will suggest many thoughts.

With certain modifications this may be repeated with gasoline and benzine in place of the coal, but it is better to use a more delicate apparatus, and to proceed in a more orderly fashion. Filling the previously described explosion apparatus with the vapor, adding air, or a mixture of oxygen and nitrogen, in air proportions, and then passing sparks of various intensities, as many as five, sometimes six, and always four, partial explosions can be produced if the oxygen be renewed and the products of the explosion be removed, and it can be seen that in addition to the part burned an increase takes place in the volume that remains up to a certain point; at the same time it can be proved that some of the fuel remains to the end. In each succeeding explosion a greater and greater spark intensity is required, or oxy-hydrogen to start the explosion, and the spectroscope shows that each is more luminous than the explosion before it. But in spite of all effort a molecule of some hydro-carbon remains which resists this process, so far as the safety of the apparatus will permit it to be carried. This last fact is emphasized by experiments on illuminating gas from which the unburned hydro-carbons can be collected.

Attempts to reproduce these results under arbitrary conditions for the purpose of measurement.—It is obvious that if a spectrum could be produced by heating carbon, or by heating a hydro-carbon and restraining its combustion (which would be comparable with that of any one or more of these obtained from the combustion of a hydro-carbon) and the temperature measured, then a distinct point would be gained towards the construction of a scale by which the temperature of molecular rupture of that given hydro-carbon could be measured approximately. There are three ways conceivable in which this could be done, first, by heating the hydro-carbon by means of its own combustion energy; second, by passing the hydro-carbon through a tube which was in some way heated and then igniting it; third, by heating a filament of carbon with the electric current.

The third method showed the best as a "comparison scale," and while it was only this at first it soon became an object of far more interest than the studies it was intended to check (but this is another story,) and made possible the continuation of the study in the line for following which these preliminary studies were undertaken.

The second method was pursued with an apparatus designed as follows and constructed with some care, but while the results were satisfactory in a way, the conditions were so evidently artificial, as compared with the usual methods of managing flames that they were abandoned and attention concentrated on the first. This method is believed to reproduce the condition that obtains in real, domestic practice more nearly, and more simply, than any other available, while the second rather suggested the methods of the regenerative burners, as the Siemens, and the like. It is true that in some respects the apparatus used was too delicate and required a personal education to handle it, and it became more reliable as acquaintance increased, and had my work been long enough continued it is possible that the "ignorance area" would have been lessened.

A very large Bunsen burner was taken as the basis of the apparatus and arranged so that the air and the gas entered under the same pressure, measured 5 c. m. from the burner, and as the openings were carefully calibrated, and as the stops were beyond the gauges, that is, the gauges were between the stops and the burners, if the pressures were varied an exact measure was obtainable as to the amount of air and gas that was consumed. To keep the flame still more under control a chimney was placed about it, and the bottom closed with a register. Passing air and gas as pleased me into this apparatus, I was able to produce a series of results of large variety, and I could distill by the heat of the combustion of some of them. A number of times I succeeded in getting vapors that would inflame at the top of the chimney on contact with the air when the only combustion result at the bottom of the chimney was a faint red glow. The gas was always lighted by sparking with the previously described condenser coil apparatus and the amount of force required to set in motion combustion in various mixtures was carefully registered.

Summary of Results.—The best result obtainable was from illuminating gas over-carburetted with gasoline; with this, all the phenomena of the "tar barrel" were reproduced, necessary changes in condition being allowed for, and then the increasing temperature of more and more complete combustion gave whiter and whiter light, but there were always some of the molecules which would not break, and others that would persistently deposit their carbon "up the chimney," from the fact that the rapid indraft of the air through the register cooled the outside of the flame; if this was checked then one of two things happened, either the combustion was incomplete and the flame became luminous or violent vortices were started in the chimney, disturbing my results.

Finally I abandoned the chimney and allowed the air free access from the outside of the flame, and then had a measure of success, but try as I might, the luminosity of the flame was less than it should have been when compared with the filament of carbon heated by the current.

The luminosity limit.—By experience the disagreeable result of the use of the chimney were got rid of, and the intense heat of the confined flame restored, by which it was possible to raise the temperature even to the point where the glass would begin to soften from the radiation, if magnesium oxide was distributed through the flame, and under the influence of this heat, a little tip of white light would show at the very end of the column of blue flames. This was solid carbon and it was white beyond anything else in the way of carbon that ever I saw, except a filament heated to a discontinuous spectrum; and it burned most freely to carbon di-oxide and when this tip was visible there was no condensation of hydro-carbons to be gotten higher up in the tube or chimney, in any way; but when there was no tip there was condensable vapor.

The spectrum of this tip showed that it was not acetylene, whatever else it might be that was giving off this light, and after much study it seems likely that it is caused by the carrying up inside the flame, as is water in wet steam, a small volume of liquid hydro-carbon of high boiling point, which is first converted into vapor, and then decomposed at a temperature very nearly that of "welding" iron; it is above the melting point of copper, it is below the melting point of gold. At present writing therefore, it is possible to say, that the limit of hydro-carbon luminosity is the luminosity of carbon between the limits of 1050 and 1250 degrees Centigrade.

How very far short of the possible luminosity of carbon this is, if the carbon is hindered from combination with the surrounding gases, only the user of the spectroscope can form an idea; but the distance is very great, and it seems almost certain that

when the appliances subsidiary to the "incandescent light" reach the level of the possibilities we will find the limit to the commercial use of carbon for illumination, and not before.

LETTERS TO THE EDITOR.

CAUSES OF ARC LAMP "OUTAGE."

In an editorial in THE ELECTRICAL ENGINEER, of November 20th, you give some figures in regard to the reliability of arc lamps, and request that some of your readers let you know, what they consider a fair allowance of irregularities.

I took the trouble some years ago, to carefully tabulate all the interruptions in the street lighting service with arc lamps, as furnished by a private corporation running about 200 lamps on an "all-night and every night" schedule. This table, covering the period of one year, was published in the *Electrical World* of November 5th, 1892.

My object at the time was to bring out figures on this subject from others, to furnish me a basis for comparison. In this I failed at that time, but possibly I might be more successful now, if you will allow me to repeat a few of the figures for the benefit of those of your readers, who might not have the *Electrical World* of the date mentioned above at hand.

The highest percentage of loss, due to faults of individual lamps, occurred during the month of July, when it came up to 0.193%, due mostly to damage done by lightning; the lowest percentage occurred in June, when it was 0.035%. The average for the year was 0.096%, or not quite $\frac{1}{10}$ of 1%.

The average interruption due to lines was 0.015%; to dynamos 0.002%, or practically nothing; to engines 0.008%; to steam piping and boilers 0.08%. This latter interruption was pre-arranged with the proper authorities, the plant being shut down during the early morning hours to replace a defective section in the main steam pipe.

The total average loss for the year from all causes in per cent. of total lamp hours was 0.202, or a trifle over $\frac{1}{5}$ of 1%. Although, perhaps the real loss is small, it will be seen that at the time this table was made, at this plant at least, the lamp was still the weakest link in the chain.

I have not had the time to digest as carefully as I did for this table, the statistics I have for the later years, but I know that we are doing better now than we did three years ago, especially as far as individual lamps are concerned. This no doubt is largely due to a thorough protection of the lines by effective lightning arresters.

PAUL LUPKE,
Trenton Light & Power Co.

TRENTON, N. J., Dec. 18, 1895.

A LONG TROLLEY ROAD FROM GREENSBURG TO PITTSBURGH.

It is the object of our company to get connection with Pittsburgh at Wilmerding, our western terminus. In the first ten miles we cater to a population of over fifty thousand and in the entire line about seventy-five thousand. This is the first long road attempted to be built under the contemptible decision of the Supreme Court requiring street railway companies to obtain all rights from abutting property owners in the townships through which it runs. All of these rights have been obtained, and we are pushing the work as fast as possible.

W. F. SADLER, JR.
Gen. Man. Greensburg, Jeannette & Pittsburgh St. Ry. Co.

GREENSBURG, PA., Dec. 14, 1895.

MULCTING A CHARLESTON, S. C., LIGHT COMPANY.

In your last issue there is a notice that a receiver had been appointed for this company and in the same issue an item regarding the latest decision of the supreme court in Colorado, as to the liability of electric companies for injuries caused by coming in contact with their wires.

The Supreme Court in the State of South Carolina has recently rendered a like decision, but the verdict was for a much greater amount, in this case $10,000, which was reduced by the judge of the circuit court to $7,500, and affirmed by the supreme court.

This amount is for the loss of only two fingers on the left hand and no other damage. This is also the reason this company is now in the hands of a receiver. Enclosed is a brief of the case.

BYRON T. BURT,
Manager Charleston Light and Power Co.

CHARLESTON, S. C., Dec. 11, 1895.

[The brief sent us shows that the plaintiff, in the case referred to by Mr. Burt, during some cyclone weather at Charleston in December, 1893, saw a broken wire, but instead of avoiding it or passing around it, seized it with his bare hand to push it aside. His hand was badly burned and he lost two fingers. The wire had been inspected just before, but might have been broken by a brick or tile from the roofs. The plaintiff was 33 years old and making not to exceed $75 a month, the accident not interfering with his work in checking and grading cotton.—EDS. E. E.]

LITERATURE.

The Intellectual Rise In Electricity. By Dr. Park Benjamin. New York, D. Appleton & Co. 1895. Cloth. 8 vo. Illus. pp. x, 611. Price, $4.

THIS epochal history, upon which its author was engaged for a long time, bears on its face the evidences of deep research and close study. It is in no sense a compilation, yet no fact of real importance has been overlooked. It is in no sense a technical book, yet it tells all that there is to be told of the slow evolution of a great science and art, from the first dim perception of the qualities of static and dynamic electricity down to the middle of the last century when the foundations of modern electricity were being laid. Dr. Benjamin has by the title given his book indicated the lines along which he worked, but while Draper comes naturally to mind, there is much in the vivacity of the style and treatment to recall Green and McCarthy. This perception of a similar method, however, does scant justice to Dr. Benjamin, who has some ideas of his own on the philosophy of history and who thinks and writes with robust vigor, as well as with a fertile imagination and an inexhaustible vocabulary.

We do not see how it is going to be worth the while of anybody to do again what Dr. Benjamin has here done, nor do we see that much real value is left to the older books when it is all summed up now with the latest evidence in logical sequence and with the desire and ability to show the underlying relations of cause to effect. It is a great gain to be able to see Gilbert, not only as a great figure in electricity, but as one who had forbears in philosophy and who was not alone in the world as an electrician. It is also a great gain to have proper credit given to other men for work heretofore attributed to rivals or buried in obscurity and oblivion. And not least of all the gain is it to have the story presented to us in brisk and stirring language, with abundant citations and quotations, set off, too, by many portraits and frequent reproductions of the old cuts.

The narrative ends with Franklin and his kite, and the full establishment of the identity between the electricity of the atmosphere and that of the various frictional devices with which for hundreds of years people had been creating the electric spark. Dr. Benjamin will leave half his work undone if, having thus brought static or amber electricity to its apotheosis, he does not in another volume, dating from Franklin, describe the dramatic unfoldings of the hundred years in which the electricity of the loadstone has been made to yield its inestimable fruits. The amber could attract dust; the magnet has proved its ability to move mountains.

Of the authorities mentioned in this wonderfully interesting book, it must suffice to say that they are innumerable; at least, they fill many pages of an excellent index. The treasures of Dr. Benjamin's library of early writers on electricity have been freely ransacked, and we infer that in many cases he has availed himself of expert help in the closer interpretation of the philosophers of the Asiatic world. The book is admirably put together, as a literary effort, and the work of the publisher is in every way commendable.

Principles and Practice of Finance. By Edward Carroll, Jr. New York, G. P. Putnam's Sons. 1895. Cloth. 8vo. pp. iv., 311. Price, $1.75.

If the financial vagaries of the American people are any criterion, no class of books is more sorely needed by the public than that to which Mr. Carroll's excellent treatise belongs. It would seem that millions of us have still to learn wherein value consists, and to realize that a nation cannot afford to risk prosperity on unsound bookkeeping and the pursuit of phantom riches. Mr. Carroll undertakes to explain the principles of finance and then to describe the direct application of those principles in the commercial business of everyday life. There is a modicum of theory in his book, but the effort is everywhere apparent to hold the reader down to vital facts. We believe many will welcome such a book as this, especially for its clear definitions of the methods of transacting business and of the instruments of credit and exchange employed. Several of the chapters deal with banking, safe deposit companies, brokers, corporations, etc.; others with negotiable paper and its treatment; and the whole sums up whatever there is of valuable and important information in the field it covers.

"Enclosed is sixty cents for a morocco filing case for your most excellent Data Sheets. I congratulate you upon the notable increase in your paid circulation of late."—Geo. U. G. Holman, Philadelphia.

THE
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CONTENTS.

COUNTRY POLE LINES.

ALMOST every winter occur violent wind and snow storms in the Northern States which prostrate long stretches of telegraph line and inflict enormous damage and delay. This year the storms have begun earlier than usual, and during the period of Thanksgiving in the region to which Chicago serves as a centre, the entire telegraphic service may be said to have been utterly prostrated by the gale that then raged with well-nigh unprecedented severity. The result was a loud outcry for underground wires, particularly in cities; but, so far as we have seen, no one came forward to suggest a method of putting the cross-country wires underground that would be feasible, even on financial grounds.

That telegraph, telephone and electric light wires in cities should be put out of sight in subways is proper and inevitable, and the trolley circuits must go that way also, before many years are past. But we do not yet see any possibility of abolishing the aerial telegraph and telephone circuits over long stretches of country, with hundreds of miles between the connecting points. An underground system seems beyond possibility from both a financial and an engineering standpoint. On the other hand, the frequent paralysis of communication by sudden breakage and collapse of the system is not only intolerable in these modern times but a source of tremendous expense to the operating companies, as well as a grave loss of income. Moreover, the constant breakage means a rapid depreciation in the value of one of the large items of property upon which telegraphic capitalization is based. Anyone who visited last month the vast middle region of this country must have been impressed by the sight of mile-long stretches of poles and wires thrown down in winrows by the pitiless scythe of the storm. Yet this destruction is going on more or less all winter, and the bill for repairs and renewals makes a big hole in earnings for dividend.

Of late, the Western Union Co. has materially improved many of its circuits, chiefly by the substitution of copper for iron wire; while the Postal Co.'s circuits which are mainly between the big centres of trade and population are notably well built and strong. But this is not enough. It would appear at first that the decision of the U. S. Supreme Court the other day throwing open railway lines to all comers was a serious matter for the Western Union, and in some senses it is, but we have always had doubts whether a railway track was a good place to put telegraph circuits along. The real question for a telegraph company, whether it has a "monopoly" or not, is, where and how will its wires be most permanent?

One of the best plans dealing with this highly important question is, we believe, entirely due to Mr. F. W. Jones, the well-known telegraph engineer and inventor, and as it may not be familiar to our readers we may make brief note of it. Mr. Jones, speaking from the standpoint of his profession and not that of the public, sees objections to wires along highways because of the exposure there to juvenile malice, traffic, and the growth of forest and shade trees. As for railroad tracks, while there are many obvious advantages, he finds objections in the smoke, soot, cinders and gases which cause great leakage of current by coating the insulators and rot the wires and poles, and in the incessant accidents that are ever requiring the trolley gang

or the buggy from the nearest supply point. The present system of repairs is very slow and cumbersome. If the wires are in trouble along a railroad, the repairer has to wait for a train, and then is usually carried either not far enough, or too far, as he must perforce alight at a station where the train is scheduled to stop, and then frequently a long distance has to be walked in storms and mud or snow with repair materials and tools. So that upon the unusually long circuits in this country it is not uncommon for wires to remain over a day in trouble, that could have been fixed in a few hours, or even minutes.

On the highway circuits the roads generally in Spring and Fall are nearly impassible from mud and snow, sometimes absolutely so. The repairers are stationed as a rule about thirty miles apart and use horses and wagons to convey them to the point where trouble exists. It is evident that both on railroads and pike lines repairs must be uncertain and slow at present.

A proper watch cannot be kept upon the wires by the repairer as he goes along, particularly when he is in a railroad car; and a repairer passing "wire trouble" unnoticed, of daily occurrence, requiring him to make a second trip. The rapid growth of villages along the principal highways causes an increase of shade trees, and the tall poles that are now used to carry the wires above them have not strength to stand an unusual wind pressure upon several wires and arms at their tops. Mr. Jones therefore believes in the acquisition of a narrow but sufficient right of way, to be owned by the company in fee simple, and thus constituting property not to be disturbed by varying franchises or legal decisions. On this Mr. Jones would erect what may be termed a series of massive wooden letter H's, not very high but allowing a lineman to travel underneath the cross-arms by means of an air bicycle such as are seen at pleasure grounds, so that at any season he could travel clear of obstacles yet not at a dangerous height. In this way the structure would be firm and solid, the wires would all be in sight yet running direct across quiet fields and pastures, except at bridges, and the lineman could see and handle every line very quickly. It is well known that the farther telegraph wires are away from the earth and other objects, the less is their electrostatic capacity, and consequently the quicker they will carry electric signals. The plan proposed by Mr. Jones has the great advantage of avoiding the retardation to which underground wires are subject, thus securing for one wire at least a traffic capacity that could not be possessed by two wires if they were buried in the earth. Furthermore his plan is elastic and practicable.

Wires can be added to the structure in numbers and at times to suit the demands of business, whereas in an underground system an enormous capital must be invested at the outset to provide for idle wires years ahead of the need of their use, and when in time all have been employed, and if even one new wire was needed, say between New York and Chicago, then another enormous expenditure of several million dollars would again be necessary to lay down another line with a large idle capacity.

In case of a breakage in the underground system, the public would probably sit in telegraphic darkness for several days before the break could be mended. But the physical quality of the new type of overhead work would obviously be as high as that of a railroad bed, and would have a tangible value for permanence that the average telegraph circuit does not know to-day, and has never known.

There seem to us to be many arguments for the plan suggested by Mr. Jones and here presented briefly. We would like to see it tried thoroughly. The present state of frequent collapse of country pole lines is anything but creditable to electrical engineering at the close of the ninteenth century, or to the telegraphic art that has now been practiced for over fifty years.

AVOIDABLE TROLLEY ACCIDENTS.

The recent disgraceful catastrophe at the open drawbridge in Cleveland, when a trolley car plunged with its helpless load of passengers into the icy Cuyahoga, is now paralleled by an equally avoidable and hardly less disastrous accident between Paterson and Rutherford, N. J., when motormen trying to "steal switches" or right of way in the fog brought their cars together on an incline, killing one person outright and injuring several others. These accidents are wholly preventable. They should not happen, and the men who with human life entrusted to them take such chances should find that they will be visited with the heaviest and most extreme penalty the law inflicts. To deal leniently with these offences is to invite further accidents of the same nature. If the management exerts any pressure on its men to make such desperately foolhardy attempts, it should be punished with the same rigor.

THREE CENT TROLLEY FARES.

The trolley car strike that has just occurred in Philadelphia is a natural move on the part of the men to win public sympathy at a time when the people are believed to be already in a fever of indignation against the Union Traction Co. because of its resort to an 8 cent transfer fare, since effecting the recent great consolidation. A strike at such times however may prove to have boomerang tendencies, especially as the road has now announced its intention of adopting a uniform 5 cent fare for a large part of its system. The serious side of the whole trouble is the agitation that has begun for 3 cent fares. In a city like Philadelphia of great distances this would be a burden, but if the fare and the travel could be scaled, we believe both parties to the quarrel would be benefited in the long run. As before remarked in these pages, the 3 cent fare is a live issue and may require a recoining of the little nickel piece; but it is certain that with the lower rate a lesser service will be given, if the roads are to live and pay the investors in them, the investors being also no inconsiderable portion of the community.

REGULATING SOCKETS.

We publish this week a very interesting article from Prof. Anthony on the performance of the Moore regulating sockets. As to the necessity for these little mechanisms, no discussion is needed, but it is something new to have a device shown which is not only practical but is evidently economical. It is to be hoped that the apparatus may soon find its way on the market. It will serve, too, as a harbinger of the far more important work that Mr. Moore is now engaged on in "vacuum tube lighting," and in regard to which he is making remarkable progress, producing effects of which it is no stretch of language to say that they reach the broadly commercial stage.

ELECTRIC TRANSPORTATION DEPARTMENT.

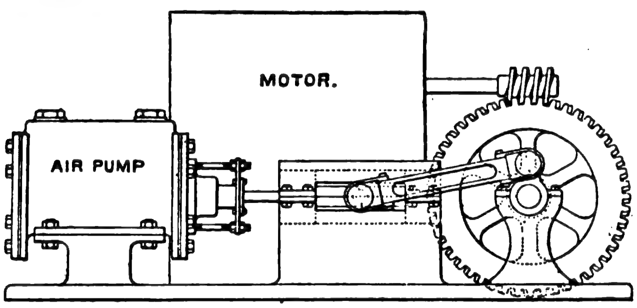
THE HUNT AUTOMATIC AIR BRAKE.

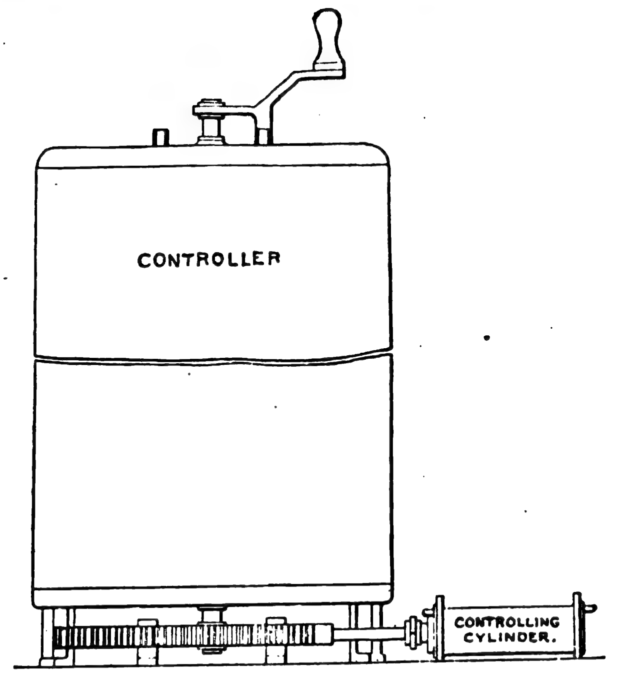
Gradually but surely the conviction is growing upon street railway managers that the hand brake is no longer adequate to provide the rapid and powerful braking which the present heavy and speedy electric cars require for safe handling, and as a result we are glad to note the rapid strides now being made in the equipment of power brakes on many lines.

The Hunt Air Brake Co., of Pittsburgh, has for some time past had its brakes in operation on a number of roads and has recently introduced a number of improvements suggested by the constantly increasing speed at which electric cars are now operated.

The Hunt system is a combination of an air pump worked automatically to keep up a pressure of 40 lbs. to the square inch in a reservoir conveniently placed so that by a system of pipes controlled by a valve in the cab—and by an emergency cord controlled by the conductor in any part of the car—the brake can be applied to the car by means of a piston in the brake cylinder actuated by air pressure from the reservoir.

In the style of apparatus used for ordinary traffic the pump is operated by an eccentric from the car axle; but with the high speeds now obtaining this method has entailed too great a strain on the apparatus, besides introducing other difficulties. To obviate all these, the Hunt Air Brake Co. have designed a system in which the air is compressed by an individual motor placed in the cab of the car. Our illustration, Fig. 1, shows in plan the new arrangement, and Fig. 2 illustrates the motor and pump.





Figs. 2 and 3.—The Hunt Air Brake Pump and Controller Operated by Air Pressure.

As will be seen, the compressor is operated by worm gearing and an independent electric motor. The compressor runs at 125 revolutions per minute. It is noiseless and occupies but little space. A maximum of but two amperes is required to run the motor, and this only for a short interval until the necessary pressure is secured in the air reservoirs, when the current consumption is only that required to overcome the friction of the motor and pump when running free, or an amount which is practically negligible.

The pump is entirely automatic being cut out when the desired reservoir pressure is obtained, by an automatic pressure regulator. This valve is placed close to the pump on the bed plate, as being more convenient, instead of being placed next to the reservoir, as at present when the oscillating pump is used with the eccentric system. It has been found more desirable to keep the pump running continuously at about 125 revolutions per minute, as the valve mentioned above cuts out the pump from discharging into the reservoir, but into the open air, thus removing all load from the pump, and requiring practically little or no power to operate it. It is evidently more economical to allow the motor to run continuously when the car is in service, instead of starting and stopping it at frequent intervals.

The motor is supplied with a fuse box, cut-out switch and starting box. The starting box is so constructed, that should the trolley jump off, or the current be cut out from the trolley line temporarily, it will automatically cut the motor out; thus every precaution is taken to protect the motor. The worm and spur wheel are encased and run in oil. The worm is made out of the best of steel, and case hardened, the spur wheel is made out of phosphor bronze. The worm wheel is 2$\frac{25}{100}$" diam., and the spur wheel, 5$\frac{2}{1000}$" diam. The motor and pump are bolted to one bed plate, so there is no danger of ever getting out of line to each other, and every wearing part or box has an adjustment to it, so that ordinary wear can be easily taken up.

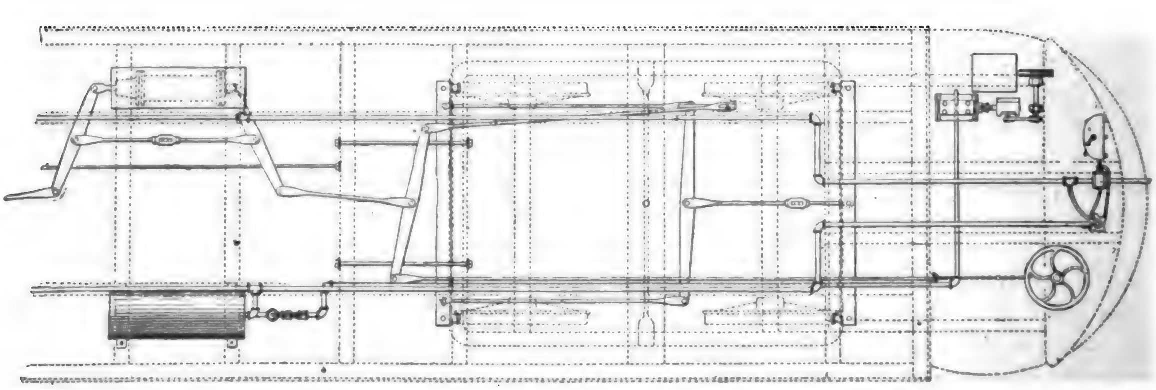


Fig. 1.—The Hunt Automatic Air Brake.—Plan of Arrangement on Car Truck.

It will be readily seen that by the use of this system all parts are much more easy of access than when placed on the truck. It is out of the dust and dirt, and the cost of maintenance is much

less. The oil cups are of sufficient size that, after once filling, they are capable of furnishing sufficient lubrication to run a whole day of 24 hours, without renewing, if necessary. The reservoir pressure can be kept much more uniform than with the eccentric system, as it makes no difference whether the car is running one mile an hour or fifty, the revolutions of the pump remaining the same. The pump will ordinarily make up all reduction of reservoir pressure used in making a stop, while the motorman is waiting for the bell to go ahead. The independent motor and pump (that is, the bed plate) occupy a space of 30 x 21", and weigh complete about 400 lbs. It can be easily hung on brackets, and placed under the car, if desired.

An interesting attachment of the Hunt system is that shown in Fig. 3, by which the controller is also operated by air pressure. This allows the motorman full control over both brake and motor by one handle. Different positions of this handle operate brake and motors simultaneously, either operating the motors with brake off, cutting the motors out of service and with brake off, or cutting them out of service with brake on, as the conditions require. The effect of reducing the number of handles needed by the motorman of course results in allowing him to exercise more attention to care of the car and reduces the liability to accident.

The system is in use on the cars of the Akron, Bedford and Cleveland high speed electric railway and on other lines.

RAILROADS AND RAILROAD SECURITIES.[1]

BY HON. FRED E. RICHARDS.

The constant progress which is being made in development of methods and invention of appliances for the economical use of electricity as a motive power must, necessarily, result in the re-adjustment of values of street railroad and industrial securities.

During the past six years great improvement has been made in electrical machinery, and superior appliances are produced at a large reduction in price as compared with the inferior articles formerly used for manufacturing and controlling electrical power.

In all probability, six years hence, these appliances which are being installed for use to-day will be supplanted by less expensive pieces of mechanism, capable of producing and utilizing electricity at less cost with better results.

Machinery, used in operating electrical properties, which was constructed in the last decade, has either been abandoned, through the influence of competition, and more modern appliances substituted, or else these properties are being operated at unnecessary expense at the present time. In either case, the owners have been subjected to great loss by having invested money in an expensive plant, incapable of producing the satisfactory results now being obtained by the lower-cost, modern plant much more economically operated.

During the years of 1888 to 1893 many miles of electric railroads were built in this country at an extravagant cost as compared with prices at the present time, and in most cases these roads were mortgaged for nearly the full cost of construction. The expectation of the stockholders of these roads that the earnings would prove sufficient to pay operating expenses, fixed charges, and leave a surplus for dividends on the stock, has not, generally been realized.

The discouraging experience of the owners of these lines in some instances has influenced them to allow the property to run down, until they now find themselves burdened with a road which has bad rails resting upon rapidly decaying sleepers, shabby cars, old fashioned motors, and unsatisfactory equipment of all kinds, with a capitalization bearing interest to an extent at least twice the amount it would now cost to build a first class road over the same location, equipped with most modern appointments and appliances.

The capitalization of electric railroads constructed six years ago was perfectly legitimate at that time, but the following comparative statement of the cost of construction then and now[2] is convincing evidence that some securities issued by street railroad companies at that time are to-day of somewhat doubtful soundness:

	1889.	1895.
Rails cost..................	$32 per ton.	$20.50 per ton.
Copper wire..............	22 cts. per lb.	11 cts. per lb.
Electric car equipment...	$3,200 for 30 H. P. per car.	$750 for 50 H. P. per car.
Trucks....................	$250 to $275.	$200 to $225.

Fish plates, bolts and spikes cost now 30 per cent. less than in 1889. Frogs switches and crossings cost now 33 per cent. less than in 1889. Poles cost 20 per cent. less; brackets for side construction cost 25 per cent. less; insulators, hangers, pull-offs, etc. (much better and more substantial than were then known,) cost 30 per cent. less than in 1889. Car bodies (greatly improved) cost 15 per cent. less than six years ago. Better generators now cost 50 per cent. less than in 1889. Engines, boilers, shafting, belts, etc., cost 10 to 15 per cent. less than six years ago. Brick stations and wooden car barns cost less, perhaps 10 per cent. Skilled labor for electrical construction (setting up cars, etc.,) cost $3 to $5 per day in 1889, and much better service is now in plentiful supply at $2 to $2.25 per day.

The item of copper wire is an important one, as will be seen by the fact that one road in this state with 15 miles of track, with its power station favorably located, has in use not less than $20,000 worth of copper wire.

A practical illustration of the relative cost of construction of electric roads is furnished in the fact that in 1889 a road was built between two cities in this state at a cost of more than $20,000 per mile, and the present year a much better road has been constructed, connecting two towns in Maine, at $10,000 per mile, the owners and managers of both properties being the same parties.

In other words, in 1889 there were very few roads operated by electricity, there were very few people who knew how to build them, and much of the material was crude as well as excessively expensive. The holders of securities of roads built at that time must recognize and bear the burden which the changed conditions have placed upon their shoulders.

The experience of the past suggests some problems for the future. While it can hardly be expected that the ratio in reduction of cost of construction will be maintained, the inventing of new appliances for the economical manufacture, control, transmission and distribution of electrical power will continue. In many cases street railroads have been operated under a franchise which expires by limitation within a few years.

The public demands rapid communication, satisfactory conveniences, and the best service for the minimum expense. Capital is abundant and enterprise is seeking new fields for investment and as old franchises expire it is not unlikely that the representatives of the people, whose charity is always first for themselves, will grant new privileges to other syndicates, if they agree to give the public better service for a penny than has been afforded by the old companies for a nickel.

The enormous traffic of many street railroad systems produces earnings sufficient to meet the interest charges even upon the excessive capitalization as measured by the present cost of construction, and in such cases, if the companies are fortified with perpetual and exclusive franchises, danger of loss to the holders of the securities is slight.

While electric street railroads have afforded great public convenience, it can hardly be claimed that, taken as a whole, a profitable return has been received by investors who have furnished the money for their construction. Notwithstanding this fact, a supply of money seems to be ready in sufficient quantities to establish street railroad systems, and this is by no means confined to localities where public necessity or convenience demands railway service. All over the country steam railroads are being paralleled between points of importance and profit in local traffic, and while as yet managers of steam railroads have manifested no anxiety about this competition, they can scarcely be ignorant of the fact that parties apparently responsible are already quietly formulating plans to consolidate existing lines of electric roads under one management, and then procure the necessary additional franchises for the purpose of filling in the intervening connecting links.

Under the statute laws of several states, established lines of railroads are protected against being paralleled by the construction of new steam railroads, and unless these laws are construed to apply to electric roads as well, the purpose of this statute is effectually defeated.

There would seem to be a distinct field of operation for steam and street railroads without encroaching upon or interfering with the legitimate business of each other, and while public convenience must receive full consideration, if existing statutes controlling the location of steam railroads are wise, it is certainly inconsistent for states to grant franchises for the location of railroads operated by a different power to traverse the highways all over the land in competition for long distance as well as local traffic with the steam railroads.

While the building of street railroads for comparatively long distance travel is just now fashionable, it is, nevertheless, as yet experimental. The future will determine whether it is sound policy to permit corporations to place upon the market, without restriction or limitation, securities based upon electric railroad properties, the mileage of which runs through sparsely settled territory connecting distant towns already supplied with railroad facilities. Not only are such securities of problematical value themselves, but the earnings of competing steam railroads may be reduced to a degree sufficient to impair the value of outstanding bonds issued upon old-established railroad properties.

1. *Portland, Me., Evening Express.*

2. Mr. Richards informs us that the figures here given are taken from the records of actual transactions occuring in the two years named, on roads in the State of Maine. EDS. E. E.

KNOXVILLE, TENN.—The owners of the Knoxville Street Railway (J. Simpson Africa, trustee, president Union Trust Co., Philadelphia) have bought the controlling stock of the Knoxville Electric Light & Power Co. and the Tennessee Electric Light & Power Co. C. C. Howell is agent for the trustee, W. S. Shields, treasurer, and J. C. Duncan, manager.

SOME COMMENTS ON BRAKING.

BY

It is not generally understood that, theoretically, there is a minimum limit within which cars of given weight and velocity can be brought to a standstill, even with the most efficient brake that can be devised.

This limit is determined by the adhesion between the wheels and rails which at its maximum does not vary greatly from one-quarter of the weight applied on the wheels. This constitutes the force with which the car is retarded.

More important even than this is the fact that with the car running at higher speeds, the braking effect (with a given pressure on brake shoes) is less than at lower speeds. Consequently a much higher pressure may be applied then, without danger of skidding.

It is not practicable, however, to thus apply a greater pressure at the *first* instant of application and afterward reduce it as the car slows down (except as a hand-brake might be released the instant before stopping), but it will readily be seen that to make a stop in the *quickest possible time* in the shortest space, the brake should be applied with its maximum force (i. e. the force just short of what would cause wheels to skid), *in the quickest time possible.*

The interval necessary to take up slack in the brake mechanism should be reduced to a minimum and, for quick action, air-brakes are more to be relied upon than *any* mechanical brake, as with them there is no chain-slack to take up and no precious moments are wasted.

The means by which this quick action becomes possible is the brake-cylinder. This usually consists of an iron cylinder with piston and piston rod, spring, lever and other parts.

The piston rod is connected with the brake lever so as to act positively and release quickly. The rear end of the brake-cylinder is air-tight and connected with the train pipe. When air is applied from the reservoir, it forces out the piston rod and sets the brake-shoes. The cylinder piston is directly connected by main lever to brake beam. It furnishes power where it can be quickly and effectively applied. It also obviates the necessity of using multiple levers, rods or chains, such as are required with hand or friction brakes.

The maximum force with which the brake-cylinder acts is constant, and is determined by the pressure of compressed air in reservoirs. Hence the force with which the piston acts does not depend upon the discretion of the operator.

The brakes are applied within the time required for the piston to travel 6". There is no excuse for misuse. The operator has perfect control either of one car or a whole train.

By means of the air-brake he can apply to every wheel "the exact degree of force required to hold wheels just short of the skidding point."

He thus makes the best possible stops and avoids noise, jarring, and injury to apparatus. The use of air-brakes absolutely prevents flat wheels and this has been demonstrated readily on numerous passenger and freight cars.

It is a significant fact that for two years past all through freight trains even on the New York Central & Hudson River R. R. have been controlled by air-brakes to the absolute exclusion of all forms of hand-brakes.

This is an object lesson well worth mastering by every thoughtful railway manager and by every subordinate who aspires to better rank.

INTERURBAN TROLLEY LINES IN MISSOURI.

A special dispatch from St. Louis, Mo., of Dec. 12, to the New York *Evening Post* says :—The utility of trolley lines for interurban traffic has been practically demonstrated in two or three sections of Missouri recently. The latest road to open for such business is the Forest Park and Clayton Electric Railway, which was put in operation last Monday. Clayton is the county seat of St. Louis County, and Forest Park is in the extreme western suburbs of this city. Until recently, the only way to reach Clayton was by one steam railway, trains making but two trips each way daily. The cars over the new line start from each terminus every twenty minutes. Under its charter the line may haul freight, and a car for that purpose will be put on soon. A number of other interurban lines are being built or are in contemplation.

At the next meeting of the Missouri Legislature a bill will be introduced permitting all trolley lines to carry freight and express matter under certain restrictions. Two St. Louis lines are already doing so, being authorized by special legislation. Preparation for hauling freight involves a good deal of trouble and expense. Rails laid for the purpose of passenger traffic are not adequate for a large freight business, and there are other items which in the aggregate make a pretty sum. A president of a company said to-day : "It is only a question of a very short time when all interior towns will be connected by trolley lines, owned mainly by local capital. This is an assured condition of the future which steam-railway men are already beginning to realize."

COST OF TROLLEY OPERATION IN CONNECTICUT.

ONE of the most prominent trolley experts in Connecticut, who is not connected with or in the interest of any trolley company, has prepared from the official reports of the trolley companies of the state made to the Railroad Commission the annexed table which shows the cost per passenger tested in the one column by operating expenses and fixed charges, in the other column by operating expenses alone :

Companies.	Operating expenses and fixed charges.	Fares.	Operating expenses.
Bridgeport Traction	$.048	5 and 10	$.031
Bristol and Plainville	.017	5	.016
Central R. R. and E. Co. (New Britain)	.080	5 and 10	.057
Danbury and Bethel	....	5	.038
Derby Street	.050	5	.041
Fair Haven and Westville	.040	5	.038
Hartford and Manchester	.069	5, 10, 15	.049
Hartford and West Hartford	.064	5, 10, 15	.051
Meriden Electric	.052	5, 8, 10, 15	.036
Hartford Street	.048	5 and 10	.036
Middletown Street	.047	5	.053
New Haven Street	.042	5 and 10	.038
New Haven and Centreville	.049	5	.027
New London Street	.034	5	.037
Norwalk Street	....	5 and 10	.037
Norwich Street	.035	5	.036
Norwalk Tramway	....	5 and 10	.031
Southington and Plantsville	....	5 and 10	.056
Stamford Street	....	5, 8, 10	.051
Waterbury Traction	.043	5	.038
Westport and Saugatuck	.056	3, 5, 8	.054
West Shore	.099	10	.055
Winchester Ave	.035	5 and 10	.038
Average	....	....	.039

The total number of single-track miles of trolley road in the state is 301 miles. Of the roads the Bristol and Plainville is entirely a country road save as it connects those two places. It is 7.7 miles long. The West Shore, 4.1 miles long, between Savin Rock and Woodmont, is practically a "summer" road connecting those two resorts. The largest system in the state is the Hartford Street Railway, with 60.7 miles, the smallest road the Southington and Plantsville, 1.57 miles long. The outstanding stock of the twenty-three roads is approximately $7,794,240, of which $2,098,000 has been paid in as cash. The total bonded debt is about $7,414,500.

THE METROPOLITAN CONDUIT ROAD IN WASHINGTON.

THE Metropolitan R. R. Co., of Washington, D. C., has now had running for some time 8 miles of road equipped with conduit. As this has operated successfully, the remaining 14 miles of the road is being similarly equipped under the able supervision of their engineer, Mr. A. W. Connett.

The power house now in use at the foot of 4½ St., near the arsenal, contains three 300 K. W., G. E. generators, direct connected to Greene compound engines. This plant operates the eight miles of finished road and will also supply current to 7 miles of the section now being altered.

The remaining 7 miles of new conduit will be supplied from what was at one time during the Company's electrical experiments a storage battery charging plant. This now contains a 200 K. W. belted T. H. generator, which will be rewound to give 500 volts ; two similar units will be installed.

COMPENSATING DEVICE AGAINST THE EFFECT OF ELECTRIC RAILWAYS.

At the last meeting of the Elektrotechnischer Verein in Berlin Dr. O. Frölich read a paper on, and gave demonstrations with, a "Compensating Device for Measuring Instruments." He proposed, for compensating purposes, that a number—say seven—of thin wires be connected with the point of the rails nearest to the instruments and led to box-shaped frames which would be placed over each instrument. All frames, with their various windings, the wires of which were to be insulated from each other, would

be connected in series. In the various leads small regulating resistances would be inserted in order to vary the pressure of the current at will. Dr. Frölich said that the experiments in Dresden and Pankow-Berlin with his device had given very satisfactory results, but the arrangement was unfavorably criticised by Dr. Kohlrausch.

NEW POSTAL TROLLEY CARS IN BROOKLYN.

The Brooklyn Heights Railroad Co., Brooklyn, N. Y., inaugurated on the 16th inst. a system of railway mail service on its trolley lines. The cars were built by the J. G. Brill Company of Philadelphia, and differ materially from any yet seen in that city. They are considered the best type planned so far for mail use. Their appearance is handsome. The cars are white, with gold trimmings and lettering. They are 24 feet 8 inches long inside and 35 feet over all. The mail compartment is 12 feet inside measurement, by 7 feet 4 inches wide, is fitted up with standard steam railway post office fittings, consisting of 200 pigeon holes for distribution of mail, and with standard pouch racks, sorting tables, etc.

The passenger compartment is also 12 feet in length, finished in cherry and reversible Hale & Kilburn seats upholstered in spring rattan, and seats comfortably twenty passengers. Electric call bells are opposite each seat for signaling the conductor. The platforms are 4 feet 6 inches long, with rounded dash, open on one side and a large single door near the step, instead of in the centre of the car, as customary. They are lighted by eight lights in the passenger end and ten lights in the postal end, and also furnished with platform lights and electric headlights. The passenger end of the car is equipped with the Consolidated Car Heating Company's electric heaters, and the postal end with the Central Electric Company's heaters. The cars are all mounted on double trucks, eight wheels under each car, making a very comfortable, easy riding car.

New Postal Trolley Car, Brooklyn, N. Y.

THE BROOKLYN THEATRE TROLLEY CARS.

Theatre trolley cars are to be introduced on the system of the Brooklyn Heights Railroad Company. They will be 25 feet long, will have fore-and-aft trucks of four wheels each and will be finished on the interior in hard woods. The floors will be carpeted with heavy body Brussels. Silk and plush drapings and lace curtains will hang about the windows. There will be fifty rich plush upholstered chairs of comfortable pattern in each car and movable tables will be supplied upon which passengers may play cards, or which may be used for serving drinks or other refreshments, for each car will be equipped with a buffet and supper can be served en route if desired. The cars will be chartered by theatre parties and they will run anywhere on the system of the Heights Company that they may be called for. An official of the company says: Other large cities where the trolley is used have these drawing-room cars, and Brooklyn should not be behind them. It is probable that the cars will be popular with theatre-goers, because of the fact that parties can go to the theatres in cars that are really warm, well lighted and thoroughly comfortable. In one of these cars a party can attend a play and have a light supper of salads, etc., served in the car afterwards. The party would thus do away with the objectionable features of eating in a crowded restaurant. And, again, there need be no delay in getting home. The luncheon can be served while the car is on its way to the point from which it started. A party can charter one of the cars and have it at any point on our system at any time desired. A thoroughly competent motorman and a gentlemanly conductor will be in charge of each of the cars.

POWER TRANSMISSION.

THE VARIOUS POWER PLANS FOR NIAGARA FALLS.[1]

BY ANDREW H. GREEN.

The great increase of projects to take water from the Niagara River that have already received legislative sanction, added to enterprises to utilize the more distant waters of the lakes, which waters are essential to the integrity of the Falls, has become the occasion of a general apprehension that the spectacle of the Falls is likely to be impaired.

The following named companies now claim rights to take water from the Niagara River above the Falls without any limit of quantity, and without any compensation for it:

1. Lockport Water and Electric Company, capital $10,000,000.
2. Niagara County Irrigation and Water Supply Company.
3. The Lewiston Water Supply Company, capital not to exceed $50,000,000.
4. The Buffalo and Niagara Power and Drainage Company.
5. The Niagara, Lockport and Ontario Power Company, capital not to exceed $10,000,000.

Besides these are the following companies now actually drawing water from the river without paying one dollar to the State:

1. The Niagara Falls Power Company, originally chartered as the Niagara River Hydraulic Tunnel and Sewer Company, claiming the most monstrous powers under a remarkable series of legislative amending acts strewn through a series of years. In their report on this subject, the committee of the late Constitutional Convention says, respecting this company:

"This company has been given extraordinary and almost unlimited power in different directions. It is authorized to conduct, convey, and furnish the waters of the Niagara River, or any power, heat, or light, developed therefrom, to, in, and through any civil division of the State, and to sell, furnish and deliver the same to any and all bodies or persons, public or private, wherever situated; and for any such purpose said corporation, from time to time, may enter upon any private property for which it may obtain such right, or upon any public bridge or street, highway, road, land, or water, and may use the ground thereunder."

This company claims to be authorized to take water sufficient to produce 200,000 effective horse power. It has paid nothing for the privileges granted. The report of the committee thus proceeds:

"If the company under discussion uses its full limit of 200,000 horse power, it will draw from the river about 6 per cent. of the entire volume of water. It may be said in passing that the same company has obtained from the Canadian Government a grant for the use of an equal amount of water to be taken from the other side of the river.

"In return for these immensely valuable franchises, the State of New York has not received one cent of any consideration, while your committee understands that for a grant similar to the one obtained on this side of the river this same company has agreed to pay our thrifty Canadian neighbors several thousand dollars per year rent, viz., about $25,000, depending upon the amount of water used.

"The State reservation at Niagara, according to the figures from the Controller's office, has cost the state of New York in round numbers $2,500,000. This reservation was founded and this immense sum has been expended to give the people not only of the State, but of the whole world, an opportunity to view at slight expense one of the grandest and most sublime scenes on the face of the globe, and if corporate and individual ambition is not checked and made subordinate to public rights, there is certainly danger that the Falls of Niagara, like the Falls of Minnehaha, may live in the tradition of song and story, but will be sadly deficient in the amount of water flowing over the brink.

"That point above the Falls on the American side at which the water may be taken is also of serious moment. A small amount diverted from the river a short distance above the cataract will affect the American Falls more than an equal amount taken from the river further away."

To create by steam one horse power costs, according to the price of fuel, from $25 to $100. This company claims the right to take 200,000 horse power, which, if created by steam, would cost at the lowest estimate $25 per horse power; but suppose, however, we take $10 as the cost of one horse power, the value of the power taken by this company will be $2,000,000 per annum.

Second—The Niagara Falls Hydraulic Power and Manufacturing Company, which now takes water from the river, is engaged without the slightest authority in enlarging its canal so that its flow capacity will be 462,000 cubic feet per minute. It pays nothing to the State.

I now lay before the Commissioners the lucid opinion of the Hon. Theodore E. Hancock, the able Attorney General of this

1. Abstract of report made as president of the State Reservation Commission at Niagara.

State, wherein he finds that this company is taking water without authority, and indicates that an injunction may be had to prevent it. Thus far the action of the Commissioners has been vindicated by the law officer of the State.

Our commission has repeatedly protested against this indefensible giving away of the property of the State, and has appeared repeatedly before legislative committees to oppose it.

The committee of the Constitutional Convention charged with the consideration of this subject made a very able and exhaustive report, and recommended the passage of an amendment to the Constitution to prevent future diversion of the waters of the Niagara River from their natural channels, except on certain conditions as to objects, compensation and quantity.

A considerable local sentiment at the Falls is favorable to these concessions to corporations, perhaps naturally enough, as they afford employment and put up the price of lots. But it is not to be lost sight of that the locality derives vast advantages from the reservation, which may be injured by these very corporations. Neither is it to be forgotten that this locality contributed but its trifle toward the establishment and protection of the reservation, that it is the property of the whole State, and that the City of New York paid half the price of its purchase, and, perhaps, pays more than half of the cost of its maintenance.

The following propositions now present themselves for your consideration:

1. What measures, in view of the Attorney General's opinion, is it proper to request him to adopt with respect to the Niagara Falls Hydraulic Power and Manufacturing Company, now taking water without authority?

2. Will the Commissioners request the Attorney General to to examine the statutes under which the Niagara Falls Power Company is now taking water, to see whether they are constitutional and whether they should not be repealed in whole or in part by reason of the unparalleled and unpaid-for advantages that they purport to grant?

3. Shall we, in the interests of the State, ask the Legislature to repeal all other charters or rights purported to be given to other companies which do not now take water, except so far as it is to be taken merely for domestic or sanitary purposes, and to be returned to the river above the Falls?

4. Shall we insist that whenever water is taken it shall be at a fair compensation to the State, and that it shall only be taken where it is to be returned to the river above the Falls, or, upon what other conditions?

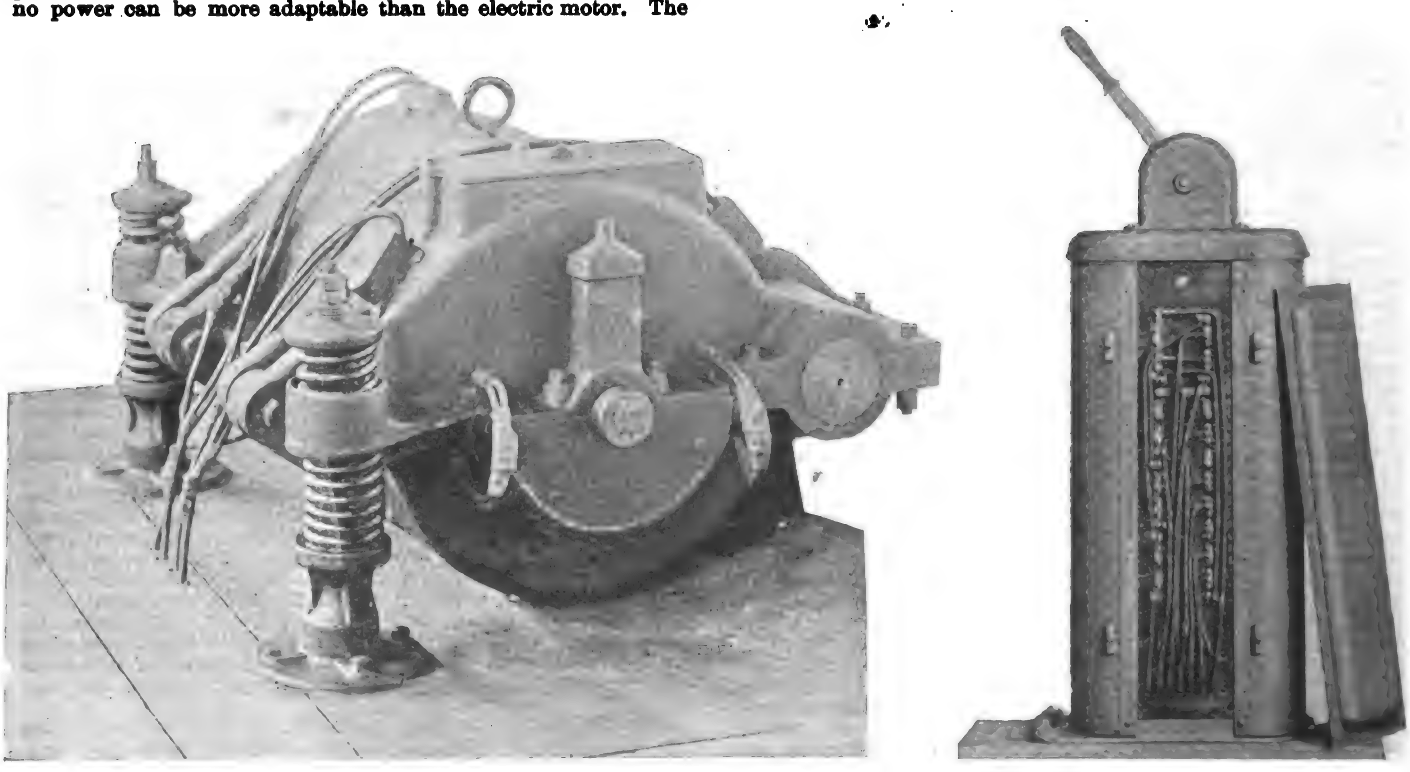
THE "CARD" MULTIPOLAR SERIES REVERSIBLE MILL MOTOR.

For operating heavy machinery in rolling mills, foundries and particularly for swing bridges and traveling cranes, in fact, all places where a strong, simple and serviceable machine is required no power can be more adaptable than the electric motor. The accompanying cuts, Figs. 1 and 2, show the "Card" Series reversible multipolar motor and controller, manufactured by the Card Electric Company, Mansfield, Ohio, for just such work. Fig. 1 shows the motor completely enclosed, so that it can be used in places where the open type of motor would soon be destroyed. This motor, in connection with the improved controller and current regulator, makes a very desirable outfit for operating traveling cranes, turnbridges, hoists, bending rolls and other kinds of machinery which require various speeds in either direction. Attention is called to the method of mounting this motor for general work. The front of the motor is supported on a cast iron stand rigidly fastened to the bed plate of the machine or other foundation, with trunnions on each side of the upper part taken through suitable bearings on the motor case, forming a pivot for the motor to swing on. The rear part of the motor is supported on springs at each side, with springs above, held in compression by bolts through the pedestals, which support them and which are also fastened to the bed plate. The object of this arrangement is to provide a flexible support for the motor and a cushion for the gearing when heavy loads are thrown on the motor or the direction of rotation is suddenly reversed. In practice it has been found to work admirably, and, in addition to saving the gears, gives the motor a noticeable advantage in starting heavy loads at slow speed. Where the conditions are such that the spring suspension is not advisable, brackets are provided on the motor for bolting to the bed plate or foundation, rigidly.

To satisfy the class of work for which this motor is designed, nothing but the best material can be used with safety, and the construction must be as thorough and complete as it is possible, with modern tools, to make it. Special pains have been taken in the design to provide large bearings for the armature shaft and other parts subjected to strains and wear, allowing in every part a generous excess of metal for mechanical strength and as a factor of safety electrically.

Fig. 2 shows the controller with the back removed, exposing the wiring and connections to contact fingers.

The controller is strongly put together and finished with iron filler or japan, as desired. The working parts have received the most careful attention. They are practically self-contained and, with the exception of the operating lever, are fastened to a back made in one piece, which can be removed from one case to another without disturbing any of the parts. Each controller is provided with two revolving cylinders, geared together and operated by the lever at the top of which are fastened a series of contact rings. The one at the right is used exclusively for opening and closing the circuit and has 24 contacts. These contacts are so arranged with reference to the motor winding that arcing is impossible. A separation of $\frac{1}{16}''$ between rings and contact arms will open the circuit without carrying current across. The cylinder at the left carries the reversing rings and others for regulating the flow of current through the motor. Of these there are 10, and the resistance between them is so proportioned that no spark follows

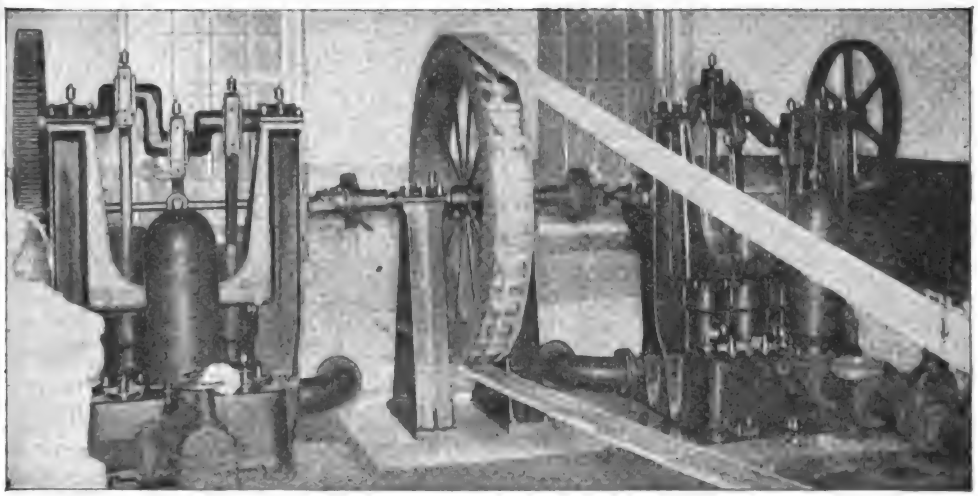


Figs. 1 and 2.—Card Multipolar Mill Motor and Controller.

when a change is made, no matter how slowly the lever is moved. Near the bottom of the controller are a series of binding blocks for making connection to the motor, current regulator and the line. These binding blocks are plainly marked with letters and figures and correspond with others on the motor and regulator. They also send with each controller a diagram of the wiring. The cylinders for starting and regulating the current are compact and strong with ample insulating resistance for use on any circuit up to and including 500 volts, and have sufficient metal in the contacts to carry a large excess of current without heating.

ELECTRIC PUMPING AT OSWEGO FALLS, N. Y.

The entire change in the conditions governing water supplies, which the introduction of electric pumping has brought about, is well illustrated in the plant recently put in operation by the Fulton Woolen Mills at Oswego Falls, N. Y. The source of supply for these mills is Lake Neahtawanta, situated about one half a mile from the mills, and here a substantial brick pump house has been built, 25 ft. × 85 ft. in size. The accompanying view is from a photograph of the interior of this building. The pumping apparatus consists of two 8-in. diameter and 12-inch stroke of cylinder triplex power pumps, made by the Goulds Manufacturing Company, at Seneca Falls, N. Y. The pumps at 40 revolutions per minute have a capacity of 624 gals. They are operated by a Westinghouse motor, running at 1,300 revolutions per minute, which is belted to a counter-shaft, to which the pump shafts are connected by means of two friction clutches, rendering it possible to operate the pumps singly or in pairs, and to start or stop them without the necessity of stopping the motor. The current for operating the motor is supplied from the dynamo which is used to light the mill, and the entire installation shows the adaptability of electric power in furnishing water supply not alone for mills and factories, but for domestic use and fire purposes as well. The application of electric power to pumping is going on very rapidly not only in small installations but for extensive plants of the largest capacity, such as city water works.



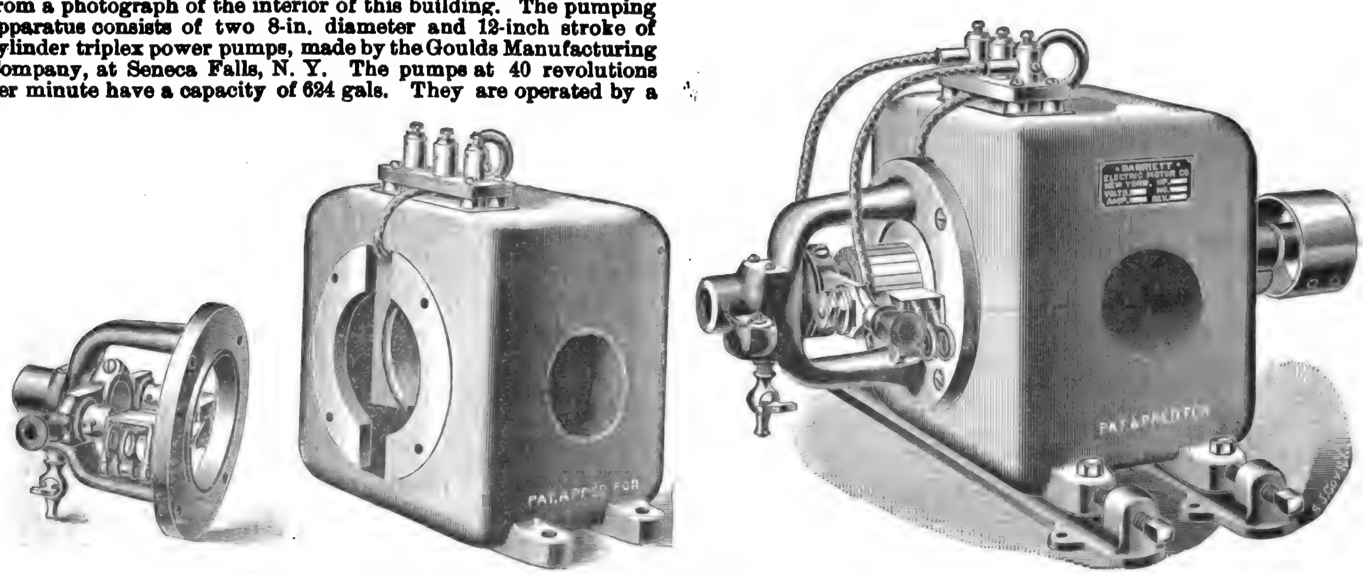
GOULDS ELECTRIC PUMPING PLANT, OSWEGO FALLS, N. Y.

THE NEW BARRIETT MOTOR AND DYNAMO.

THE accompanying engravings illustrate a novel form of electric motor and dynamo designed by Mr. S. L. Barriett, of the Barriett Electric Motor Co. of New York. The complete machine is illustrated in Fig. 2, while Fig. 1 shows the form of the magnetic circuit which constitutes an enclosed case with openings on the sides. This construction allows the field coils to be wound independently on forms and then slipped into place.

As the field case is made of one piece of soft cast steel it results in the shortest and most compact form of magnetic circuit, free from external magnetism.

In the construction of the dynamo the case is bored one size right through and put on an arbor and the sides faced off. The bearings are bored and faced off and the projections are turned to fit the bore; by this means the alignment becomes perfect. The armature is of the usual drum form with comparatively few turns of wire, which allows it to be made true and symmetricaly, a very important point in armature construction. The field coils are wound on forms heavily taped and baked, making them moisture-proof and easy to dampen.



FIGS. 1 AND 2.—BARRIETT MOTOR AND DYNAMO.—DETAILS SHOWING CONSTRUCTION.

The following are the data for the ½ H. P. 240-volt machine of this type:

Area of field	22 sq. in.
Lines per square inch	57,600
Lines generated	1,267,600
Active lines cut	1,056,000
Leakage coefficient	1.2
Rev. per. sec. (*n*)	16
Inductors on Armature (*c*)	1440
Resistance of field magnets	800 ohms
" " armature	2 "

TELEPHONY AND TELEGRAPHY.

TELEPHONES FOR MICHIGAN PEACH GROWERS.

The question of a telephone plant for the use of farmers has been successfully solved in Oceana County, Mich., the great peach growing district. This year a telephone company was organized by the farmers and forty miles of wire is in operation, with thirteen stations. It has proven a great advantage to the fruit growers, for they can learn prices without driving to Hart, the central point, saving an immense amount of time. Much of the business which heretofore has required a trip to town is now transacted over the wire. The cost is small and the system will be extended next year.

A REPORT ON TELEPHONE SERVICE IN ST. PAUL, MINN.

One of the cities in which there has been a brisk agitation for lower telephone rates is St. Paul, Minn. The Chamber of Commerce thereupon referred the subject to a committee which has just reported, as follows:

The committee have had three meetings and have had before them W. B. Joyce, a former manager of the telephone company in this city, and C. P. Wainman, general superintendent, and B. L. Freedy, the present manager. The committee have also investigated the charges for telephone service in Duluth, Milwaukee, Detroit, Buffalo, Boston, Omaha, Cleveland, Cincinnati, St. Joseph and Kansas City, and find that the rates charged in this city are as low, and in most instances lower than any of the cities above mentioned, and that the service and facilities are in most cases superior.

During the past four years the Telephone Company have incurred large expenditures in the improvement of their plant by the adoption of superior instruments, switchboard appliances, etc., all of which have greatly benefited the service. The company have also placed nearly all their wires underground in the business portion of the city and removed nearly all the poles from the streets. There are still a few poles remaining, but which will be removed in the near future.

The charges for telephones in private residences on St. Anthony hill have, on account of the distance from the telephone exchange, been a little higher than in some other sections, but a branch exchange is now being put in on the corner of Dale and Selby avenue, which will very materially reduce the charges on about 300 telephones in that district. It is expected that this exchange will be in operation by March 1, 1896.

In view of the large expenditures of the Telephone Company in improving the service, and that no advance in rates have been made during that time, and that rates charged in this city are as low or lower than in other cities, the committee are of the opinion that at the present time it would not be practicable to ask any reduction.

New telephone companies are being exploited in various sections of the country, and new exchanges are being put in in some cities, but your committee is not familiar with the merits of these new companies, and so far as we are able to learn, they have not as yet effected any decided change either in the service or rates charged. If these new companies have, as is claimed, superior appliances and can afford a service equal to that we already have, and at a less cost to the subscribers, your committee have no doubt this chamber will give them hearty support in the establishment of an exchange in this city.

THE COST OF TELEPHONES IN CONNECTICUT.

President Morris F. Tyler of the Southern New England Telephone company, said in an interview recently when asked if the prices for telephone service would be reduced on the expiration of the present patents: "I think not. In fact, I do not know when the next royalties will expire. That will not affect the prices in the least for they are about as low as can be afforded now when the maintenance of the plant is taken into account. We furnish house telephones for $3 per month and the price was formerly $50 per year. When a special wire is given a house the price is now $48 per year and it was formerly $65 per year. For business houses the price is $72 per year as against $120 formerly. So there is quite a reduction in price. I understand that one of the managers of the new company which proposes to locate in New Haven and also in Bridgeport, has stated to customers that their telephones could be connected to our line. Now that cannot be done. Down in Stonington where a rival company proposed to come in after we had taken out our service, when it was found that the local telephone could not be connected with the outside service, then the authorities refused to allow the rival line to come in there.

"The multiple system is to have quite a growth," continued Mr. Tyler. "This village system, as it is called, we are now putting in at Mystic and will place the system in a number of villages in this state next year. It costs customers only $18 per year and 25 customers can be accommodated. This system does not require any central office and by using a plug a telephone can be connected with the outside service. We cannot establish a central office where the business does not pay an income of $1,200 a year, as it does not pay the outlay. Each subscriber can call up any-one on the line in the village and the system works very conveniently.

CABLE TO CUBA.

A SPECIAL dispatch from Washington, of Dec. 16, says:—The proposed construction of a telegraph cable from the United States to Cuba was brought up anew in the Senate this session by a bill introduced to-day by Mr. Carter which contemplates the building of such cable by a private corporation. The company is organized under the laws of New York, and asks for authority to lay its cable through the waters controlled by the United States and make a landing on the coast. It agrees to complete the work within two years, and asks, as an indirect subsidy from the Government, a contract to carry any and all Government messages at the rate of $25 per nautical mile per annum, without additional charges of any character.

WESTERN UNION DIVIDEND AND FIGURES.

The Western Union directors have declared the regular quarterly dividend of 1¼ per cent. The Western Union Telegraph Co.'s figures partly estimated, for the quarter ending Dec. 31 compare as follows:

	1895.	1894.	1893.	1892.
Net	$1,700,000	$1,600,000	$1,550,000	$2,000,000
Int. & Skg. fd	243,550	242,800	243,262	243,835
Balance	1,456,450	1,357,200	1,306,738	1,756,165
Dividend	1,191,945	1,192,000	1,185,000	1,185,250
Surplus	264,505	165,200	121,738	571,415

October actual; November and December estimated.

Estimated net for Sept. 30 quarter was $1,850,000, and actual proved to be $1,842,648.

BELL TELEPHONE DIVIDENDS.

Directors of the American Bell Telephone Company have just declared a regular quarterly dividend of 3 per cent. and 1½ extra. This makes a total of 15 per cent. declared this year—12 per cent. regular dividends and 3 per cent. extra, 1½ per cent. being declared June 12 and 1½ extra yesterday.

WHAT TELEPHONIC "BUSY" MEANS.

In one of its recent pithy little pamphlets, the New York Metropolitan Telephone and Telegraph Co. says: "It should be clearly understood that when an operator reports "busy" to a request for any number, it is meant that the line *called for is in use.* From the moment an operator connects herself to the line of a calling subscriber to answer his call, that line is automatically protected against interruption on the part of any other operator who may wish to connect with it. The line remains so protected during the progress of the communication and until the ring-off signal has been given and the disconnection made. As every line is available for connection with others at a number of different points in the exchange, this automatic system of protecting a line from interruption from the moment it is put in use by the subscriber is absolutely necessary to prevent the confusion that would otherwise arise by reason of simultaneous calls from different parts of the system for the same number."

TELEPHONE NOTES.

VACAVILLE, CAL.—The Vacaville and Winters Telephone Company has been formed. Principal place of business, Vacaville, Solano County. Capital stock, $5,000; with the following directors: E. R. Thurber, T. K. Buck, William H. Buck, F. B. McKevitt, Vacaville; Henry Bruick, Winters.

THE METROPOLITAN TELEPHONE CO. has purchased the property No. 17 Dey street. The adjoining property, Nos. 13 and 15 was previously acquired. The company, it is said, proposes in the spring to build a ten-story fire-proof building on this spot, to connect with its present building in Cortlandt street.

JERSEY CITY, N. J.—Articles of incorporation of The Home Telephone Company of Jersey City have been filed with the county clerk of Hudson County. The incorporators are Ernest J. Foord, P. Justus Atkinson and George H. Atkinson, all of Jersey City. The capital stock is to be $300,000, of which $100,-000 is paid in.

"ONE OF THE ABLEST." Discussing the subject of conduit roads, the *Chicago Post* quotes the "statement of THE ELECTRICAL ENGINEER, one of the ablest technical papers devoted to electrical science in the English language."

MISCELLANEOUS.

THE STORAGE BATTERY OR THE GAS ENGINE AS AN AUXILIARY.[1]

BY NELSON W. PERRY, E. M.

WHETHER it is economical or not to equip a central station with an auxiliary storage battery plant is a question which must be decided separately for each particular installation. Generally speaking, the question will be decided by the character of the load line—a broad topped curve being the most unfavorable and a sharp peak the most favorable to storage battery economy. Again, a station having a very light day load may use the battery to good advantage even though its night load may present a broad topped aspect. Aside from purely economic reasons, convenience may be controlling, so that it is impossible to state, unless all the conditions are known, whether the storage battery is advisable or not.

The price of the battery is an important element, of course, but less so than popularly supposed, for the space which it occupies and the cost of maintenance may largely overbalance any gain in first cost over the cost of the extra boiler, engine and dynamo.

In regard to the cost of maintenance, manufacturers are willing to guarantee that it will not exceed 10 per cent per annum, but it is well to understand just what this 10 per cent. means. It means, in the first place, that if you put in all the battery power that the manufacturer recommends and take care of the battery exactly as he says, then the guarantee holds good. Under such conditions the manufacturer is undoubtedly safe, but if we install a plant under these conditions we are pretty sure to find that the economy in first cost of the battery over engine and dynamo has entirely disappeared.

As before indicated, there are some situations in which either convenience or extreme steadiness of current may be controlling in deciding the question of the use or not of storage batteries. But where the question is one purely of economy, I would not myself recommend their use under any circumstances simply because there is a still more economical method at hand. I refer to the gas engine. Even if it were necessary to use illuminating gas from the street mains it would be more economical (considering space and other factors), to take the peak of the load with a gas engine than to install a battery for this purpose. In this case there would be no standby losses and the engine would be ready at a moment's notice to be thrown into service.

It is a fact that has been amply demonstrated by others as well as myself, that a given number of lights can be produced with half the gas burned in a gas engine that is required to produce them in ordinary burners. The mechanical efficiency of the gas engine is not quite so high as that of large compound condensing steam engines, rarely ever exceeding 83 to 85 per cent. while the latter may go to 90 per cent., but the total efficiency from fuel to the pulley of the gas engine is about double that of the steam engine—reaching 25 per cent. under favorable conditions, whereas, with the steam engine it rarely equals 12 per cent. So that with the gas engine operating at anywhere near its full load there would be a gain in efficiency instead of a loss of say 20 per cent. where the battery was used.

As indicating the performance of a gas engine using illuminating gas at various loads, I quote the following figures obtained from a test of a 12 H. P. (actual) gas engine.

Actual H. P. developed.	Gas consumption (cu. ft.) each actual H. P.
12	15
11	15.3
10	15.5
9	16.
8	16.5
7	17.
6	18.
5	19.
4	21.
3	26.
2	30.
1	48.

These figures are somewhat better than would be obtained in practice, but go to show that the gas engine compares favorably at light loads with the steam engine under similar conditions.

Thus far I have spoken only of illuminating gas but the power may be much more cheaply generated by using a fuel gas.

The cost of producers or generators comes to about $11.00 per H. P. capacity—considerably less than the cheapest boiler and an idea of the space required may be gained from a statement of Mr. J. Emerson Dawson who in estimating for a plant of 400 K. W. capacity says that if the gas plant is all on one level it would occupy a ground space of 27 feet by 54 feet, but if necessary, all except the gas holder can be placed under or over the engine room. His estimate for such a plant is, including erection, foundations and ash pit for generators $5,500 or $10.38 per H. P.

These fuel gas generators can utilize advantageously the poorest grades of fuel, and produce from the better grades of anthracite about 160,000 cubic feet of gas of a calorific value equal to one quarter that of 16 C. P. illuminating gas, per ton of coal.

As to the standby losses of the gas producers, this has been very carefully determined in a number of cases. As an illustration I will cite a single case—by no means the best on record.

At Openshaw a generator which supplied gas for from 250 to to 300 I. H. P. was shut down for 41 hours and the fuel consumption during this time was but 3.9 pounds per hour or about one per cent. When we compare this with the standby losses of the steam boiler which is estimated by Prof. Kennedy at ten per cent. of the total consumption in all the boilers, we see how insignificant it is.

A situation usually considered peculiarly adapted to the storage battery is in subordinate or outlying stations where they are charged during the day time from the central station and act as centres of supply during the night time. But gas can much more economically be distributed to these stations than can the electric current, for Mr. Denny Lane[2] has shown that with ordinary 16 C. P. gas, 3000 H. P. can be sent a mile for an expenditure of one H. P. or one-thirtieth of one per cent. of the power conveyed.

My own calculations show that a six inch pipe will deliver 6,000 cubic feet of gas per hour at a distance of 10,500 feet under four inches of water pressure. If this be 16 C. P. gas, allowing 25 cubic feet per H. P. hour, this quantity represents 240 H. P.

Cast-iron pipe, six inches in diameter, having a thickness of ½ inch, weighs 31.9 lbs. per foot. The total weight of this two miles (nearly) of pipe will therefore be 334,950 lbs. This would be equivalent in conductivity to about 41,869 lbs. of copper. But four miles of copper weighing 41,869 lbs. would be equivalent to about four No. 000 B. & S. wires, which would have a resistance for the four miles of 0.325 ohm. If the charging current were transmitted at 220 volts, there would be required a current of 845 amperes; but a wire having a resistance of .325 ohm will only deliver under a pressure of 220 volts 220 ÷ .325 = 677 amperes, there would, therefore, be required five No. 000 B. & S. wires to deliver this energy, and the weight of this would be 53,540 lbs.

If the distribution took place at 1,000 volts, the amperes required would be approximately 180. To deliver this at the same distance with a loss of 10 per cent. would require 6,264 lbs. copper, and to deliver it at one per cent. loss would require 62,642 lbs. which would cost far more than the pipe and still give less efficient transmission.

I think it would be very easy to prove that the gas engine with fuel gas would prove a much more economical auxiliary to the central station for taking the peak of the load and the loads amounting to fractions of a unit than the storage battery, and when we consider the efficiency of transmission of energy in the form of gas, which will permit of the location of the gas generators where land is cheap and fuel easily procured, it seems to me that the plan must commend itself to electrical engineers.

1. Abstract of a communication presented at the meeting of the Amer. Inst. Elec. Engrs., Nov. 20, 1895.

2. *Electrician*, Oct. 9, 1891.

CONTEMPORARY ELECTRICAL SCIENCE.

Wiedemann's Beiblätter, No. 10, contains a good selection of electrical abstracts from various remote sources.——M. Töpler has endeavored to supply all the links connecting condenser oscillations with Tesla's experiments. The oscillations were transformed to lower and to higher pressures, respectively. In the former case several new phenomena were observed which had not as yet been produced with electrostatic apparatus. In transforming up, all Tesla's experiments could be reproduced. Iron cores diminished the induction of these high-frequency currents. ——K. A. Holmgren, of Lund, has studied the electrification of air issuing from water, and obtained differences of potential of 70 volts. He also obtained electrification by a rod dipping into water and thrown into oscillations. The vessel containing the water assumed a positive charge.——M. Reiner describes a new method of measuring the potential of a metal immersed in a liquid. The liquid is put to earth by a wet thread, and the metal connected with an electrometer. Copper in copper sulphate is positive.——A. Bartoli found that both methyl alcohol and sulphurous acid possess a certain conductivity which disappears at their critical temperature, but reappears on cooling.——Signor Majorana has investigated the formation of cuprite, Cu_2O, by the electrolysis of $CuSO_4$. When a small current is passed through dilute $CuSO_4$, acidulated with sulphuric acid, ruby-red crystals of cuprite are formed, especially when the solution is heated.——H. Luggin tested the capillary electric phenomena of molten lead covered with fused potassium and lithium bromides, and mercury

covered with potassium and sodium nitrates. The capillary constants attain a maximum at lower differences of potential in iodides than in bromides, and lower in bromides than in chlorides. Helmholtz's and other theories do not agree with the facts.——E. Wiedemann describes a new kind of ray observed in spark discharges. He calls these rays discharge rays. They are not deflected by a magnet, and therein they differ from cathode rays. They more resemble the rays found in the positive light. They are characterized by the bright "thermo-luminescence" which they produce in $CaSO_4$ mixed with a little $MnSO_4$ or in the corresponding carbonates. They are absorbed by fluorspar, but not by air. Hence they are not extreme ultra-violet rays.—*London Electrician.*

SURFACE LEAKAGE IN TESTING DIELECTRIC RESISTANCE BY DIRECT DEFLECTION.

BY W. A. PRICE.

The resistance of a solid dielectric is most commonly measured by placing two conductors, maintained at different potentials, in close contact with its surface, and measuring with a galvanometer the current that passes from one to the other. This current is assumed to pass through the substance of the dielectric, and the specific resistance of the material is calculated from the known dimensions of the parts. There is, however, often a path for the current over the surface of the dielectric as well as through its substance, especially in cases where a conducting film of moisture is liable to form. This current passing over the surface

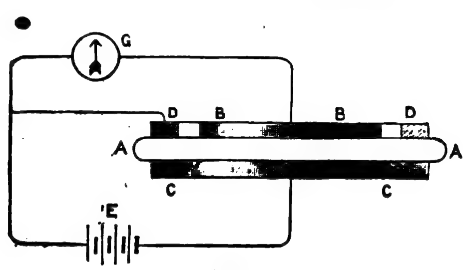


FIG. 1.

introduces an error into the result, making the specific resistance of the material appear too low. The difficulty can, however, be met by the device called, when applied to an electrometer, a guard ring.

In Fig. 1, A A, is a disc of some solid dielectric to be tested. B B, C C, are two circular metal plates on the two sides of the disc. D D, is a metal ring placed round B B, but not touching it. G, E are the galvanometer and battery connected as shown.

If the resistance of the conducting film on the surface of the dielectric between B B, and the guard ring, D D, be large compared with that of the galvanometer, B B and the guard ring will be at the same potential, and no current will flow from one to the other. The whole of the current flowing through the galvanometer into B B, passes on through the substance of the dielectric, and gives the correct measure of the specific resistance of the material.

The connections, in the case of a cable, are shown in Fig. 2.

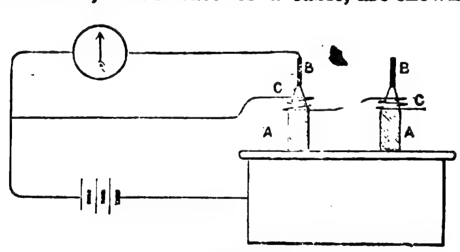
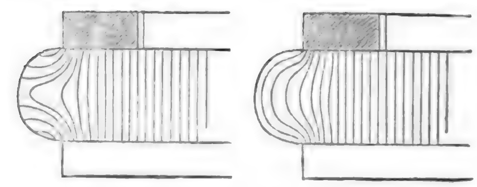


FIG. 2.

A A, are the two ends of a coil of cable brought out of the tank of water, in which the coil is immersed. The ends are shown trimmed into long tapering cones in the usual way, so as to expose a large clean surface of the dielectric, as well as the ends, B B, of the conductor. C C is a thin copper wire wound closely two or three times round the middle of the taper ends, and connected as shown. Then if the resistances of the surface films on B, C, B, C are large compared with that of the galvanometer, B, C, B, C, are all at the same potential, and no leakage will take place from B, B over the trimmed surfaces. If the conductivity a of the film between B and C is comparable with that of the galvanometer, g, the galvanometer deflection will be reduced in the proportion of $g : a + \gamma$, and must be multiplied by $\frac{a+\gamma}{\gamma}$ to obtain the correct result.

The guard ring of Fig. 1, if the gap between it and the plate, B B, is small compared with the thickness of the dielectric, causes all the lines of flow near the edges of B B to be perpendicular to the plate instead of bulging out as they would otherwise do; and an assumption that the current passing is proportional to the area of the upper plate is rendered more exactly true by the use of this guard ring, apart from any consideration of surface leakage. If, moreover, the upper area be measured within the middle line of the small gap between the plate and the guard ring, the error becomes very small indeed. It was, of course, this consideration,



FIGS. 3 AND 4.

not that of anything like surface leakage, that introduced the guard ring into the absolute electrometer, and it may be remarked that in a condenser, such as that of Fig. 1, or an ordinary cable, where the dielectric is also a conductor, the lines of electrostatic strain and of current flow coincide. Figs. 3 and 4 show the general character of distribution of these lines when there is and is not surface conduction.

Mr. Appleyard has practically tested the method applied to a piece of sound gutta percha core immersed in water. The ends were carefully cleaned and trimmed, and projected from the water by several feet. The connections were made first without any guard wire, and 20 divisions of deflection were obtained on the galvanometer scale, indicating a dielectric resistance of 18,000 megohms. The ends were lowered into the water till only a few inches remained exposed, and these were rubbed with black lead. The galvanometer deflection increased to 124,000 divisions.

The guard wire was then connected without any other alteration, and the deflection obtained was 20 divisions as before. Equally clear results were obtained by connecting an artificial leak of known resistance, one megohm, between the conductor and the earth, and joining the guard lead to different points of it.

NEWS AND NOTES.

ELECTRICITY AT THE HEBREW TECHNICAL INSTITUTE.

The electrical portion of the Hebrew Technical Institute Exhibit, at the Educational Fair now being held in Madison Square Garden, New York, is attracting great attention on account of the excellent representation of the work done, and the methods of instructions pursued in that department of the Institute.

The work is divided into two sections; one portion, occupying one side of a large pyramid, shows models of various types of dynamos, and also several of the pupils' notebooks containing a record of their experiments in the laboratory, and dynamo room, together with the results obtained. Here also are some unique plates representing the magnetic field of several dynamos. The lines of the magnetic flux are clearly shown by iron filings fixed to porcelain plates, in the positions assumed when acted upon by the dynamo field magnets; other plates show the action of magnets on one another.

The other section is a remarkable one, showing as it does the proficiency of the boys in metal work in its application to the manufacture of electrical instruments. This table contains a number of instruments of precision in everyday use in the laboratory, made by former pupils, and among them are placed specimens representing work designed especially for the electrical class. This work is of excellent quality, and speaks highly for the course, when it is known that the apparatus was all made by the present class during the first three months of its course.

The *pièce de résistance* of the electrical exhibit is a 110-volt one horse power dynamo, which is used as a motor to drive a small dynamo, designed and manufactured commercially by a former pupil. This dynamo furnishes electric current for a model house, the various rooms of which are illuminated by electric lights, operated from a miniature electric and steam plant in the cellar. The house is wired throughout with concealed wiring in the most workmanlike manner, and in accordance with the rules of the Board of Fire Underwriters. This work as well as that of illuminating a large carved sign in another part of the exhibit was done entirely by the members of the electrical class at the Institute, the ages of the pupils averaging 15 years. The electrical section individually, as well as the entire exhibit, is a most creditable showing and speaks volumes for the aptitudes for mechanical and technical work in a race which has been deemed devoid of these faculties.

PERSONAL.

SAMUEL L. BARRIETT.

S. L. Barriett.

Mr. S. L. Barriett, of the Barriett Electric Motor Co., who has earned the reputation of an ingenious electric motor and dynamo manufacturer, and who is the designer of the well-known Barriett motor, was born in 1863, in the State of Texas, where he received his early education. When he was 12 years of age he entered into the machine shops of Wiggin, Smith & Simpson and served three years at the machinist trade. At the age of 15 he was apprenticed for 8 years at the H. & T. C. Locomotive Works, became thoroughly familiar with locomotive building, and invented a system of setting locomotive eccentrics. About this time Mr. Barriett began to realize that it was necessary to educate himself further in order to develop his mechanical abilities, and began taking private night lessons in mathematics and electricity. During the early part of his studies he learned telegraphy and accepted a position as operator with the B. & O. Telegraph Co., in Chicago, where he became an expert, and was sent to Houston, Tex., to "take press" for the B. & O. In the year of 1879 he began experimenting with acoustic telephones and designed the apparatus known as the Barriett duplex self-supporting telephone. He erected many short lines in Texas. In 1882 he began experimenting with electric telephones and brought out the transmitter known as the Barriett make-and-break. In 1889 he designed an automatic return starting box, and a line of motors, and sold them to the Edison Ill. Co., of New Orleans, La., for half of the stock of the Southern Elec. Mfg. & Supply Co., which was composed of Edison people. Mr. Barriett sold out his interest, came to New York in 1890, and organized the Barriett Electric Motor Co. which turned out many motors. The New York *Times* operates its linotype machines entirely with Barriett motors; the New York Post-Office operates cancelling stamp machinery with Barriett motors also; and many printing offices use them. They are also to be found in the Metropolitan Museum, Central Park, as well as on Worthington pumps, etc. Mr. Barriett was also the designer of the electric machinery used in the fur trade for eliminating the longer hairs on sealskins, etc., so as to produce a more uniform and more valuable fur.

SOCIETY AND CLUB NOTES.

HENRY ELECTRICAL CLUB—LECTURE BY PROF. CROCKER.

AT a meeting of the Henry Electrical Club, held on Dec. 18, Prof. F. B. Crocker delivered a lecture on "Methods of Driving Dynamos." The audience was large and appreciative. In part, Prof. Crocker said that so far from being unimportant, as many were apt to consider it, the success of a plant might altogether depend on the quality of the connection between the engine and dynamo. In his experience he had observed plants with good engines and well designed dynamos fail to give satisfaction simply because unsuitable methods of driving were employed. The subject naturally divided itself into the divisions: direct coupling; belting; rope driving; toothed gearing; and such forms of connection as friction and magnetic clutches. Taking each division in turn, Prof. Crocker tersely but exhaustively set forth the advantages and defects of the various systems.

Direct coupling, the simplest method of connection, was not so nearly ideal as many supposed. The principal difficulty in direct coupling was the great difference in speed between the engine and dynamo. The engine, naturally a slow speed machine, and the dynamo, a high speed machine, had to be specially designed to meet the requirements of the system. Except in the case of large multipolar machines it was difficult to accomplish this without going to extremes in the design of the dynamo. Direct coupling, in the great majority of cases, he considered a sacrifice of the desirable features of engine and dynamo.

As a successful instance of direct coupling, he cited the Niagara plant, and described the method of supporting the weight of the vertical driving shaft and the dynamo fields by the upward pressure of the water driving the turbine. Carrying, as it did, that weight to about two per cent. he regarded it as a notable example of engineering skill.

In speaking of belting, Prof. Crocker said that much of its unpopularity is due to bad design in placing dynamos and to careless attendance. Belts properly put in and well taken care of seldom fail to work well, and he knew of no such cases of failure in which the trouble might not be traced to non-fulfillment of those conditions. The principal advantages of belts were cheapness; the possibility of operating a combination of slow speed engine with a high speed dynamo; and the fact that in case of accident the belt, being the weakest part, would fail before the ruin of the engine or dynamo could occur.

Among the disadvantages of belting were the constant slip, with consequent loss of power; fluctuation in current due to imperfect joints, and the large floor space required. He preferred ordinary leather belting, possibly perforated, to all other materials, as it is well known, reliable, and easy to apply.

Rope driving was not so well known nor appreciated in this country as in Europe, though steadily growing in favor. He characterized it as an excellent method of transmission. It combined the good qualities of cheapness, durability, quietness in running, and great power with lightness. By reason of the last quality, power could be transmitted to great distances, yet it was possible to operate in cases where the fly wheel and driving pulley were very close together. As compared with leather belting it had the advantage of showing the effects of wear long before trouble actually came. By means of a curve chart he showed the most desirable speed to run ropes, and explained how beyond a certain point centrifugal force reduced the power transmitted to zero.

Toothed gearing, even in turbine work where low speeds are employed, he considered unnecessary as the revolving parts of the dynamo can be mounted directly on the shaft.

He could see no good reason for changing the vertical line into the horizontal by bevel gears as is often done in practice.

The various forms of clutches, frictional and magnetic, were briefly described and illustrated. The magnetic clutch seemed to him to be the ideal form of connection, being frictionless, easy of control, and requiring very little current in its operation.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

AT the monthly meeting of Council Dec. 18th the following Associate Members were elected: Chas. F. Bancroft, Electrical Engineer, Lowell and Suburban Street Railway, residence, 60 Fort Hill Ave., Lowell, Mass.; Frank E. Herdman, Mechanical and Electrical Engineer, Crane Elevator Co., Winnitka, Ill.; Richard Lamb, Chief Engineer, The Trenton Iron Co., No. 1 Broadway, N. Y., residence, 72 West 69th St., N. Y.; Leon Le Pontois, Electrical Engineer, The Westinghouse Elec. and Mfg. Co., Pittsburgh, Pa.; Harry W. Ludlam, with Western Electric Co., residence, 480 Lexington Ave., New York City; Samuel G. McMeen, Assistant Engineer, Central Union Telephone Co., 1306 Ashland Block, Chicago; Frank L. Scidmore, with Western Elec. Co., residence, 480 Lexington Ave., New York City; Joseph P. Stone, Electrical Engineer, General Electric Co., residence, 218 Liberty St., Schenectady, N. Y.; Norman W. Storer, Electrical Engineer, Westinghouse Elec. and Mfg. Co., Pittsburgh, residence, Wilkinsburg, Pa.; Chester H. Thordarsson, Chicago Edison Co., residence, 896 Davis St., Chicago, Ill.; Harrison C. Wybro, Electrical Engineer, Wybro & Lawrence, Los Angeles, Cal.

The following Associate Members were transferred to Full Membership, their applications having been approved by the Board of Examiners: George Stephens, General Superintendent, Canadian General Electric Co., Peterboro, Ont.; George White-Fraser, Electrical Engineer, Toronto, Ont.; Alex. Dow, Engineer, Public Lighting Commission, Detroit, Mich.; Samuel G. Neiler, Assistant Electrical Engineer, Pierce and Richardson, Chicago, Ill.; L. Knowles Perot, Vice-President and General Manager, Schuylkill Valley Illuminating Co., Phœnixville, Pa.; John Balch Blood, Assist. Engineer, Railway Department, General Electric Co., Schenectady, N. Y.; Franklin Sheble, Electrical Engineer, Philadelphia, Pa.; William H. Freedman, Tutor in Electrical Engineering, School of Mines, Columbia College, New York City; Andrew L. Riker, The Riker Electric Motor Co., Brooklyn, N. Y.; John A. McCrossan, Manager and Electrician, Citizens' Telephone and Electric Co., Rat Portage, Ont.

The following Committee was appointed by President Duncan to consider the question of incorporation of the Institute, and any revision of the Constitution that might be necessary to comply therewith: W. B. Vansize, Esq., Chairman; Prof. H. S. Carhart, Mr. W. F. C. Hasson, Mr. A. S. Hibbard, Dr. Cary T. Hutchinson, Mr. T. C. Martin and Mr. Townsend Wolcott.

CHICAGO ELECTRICAL ASSOCIATION.

The Chicago Electrical Association has resumed its sessions, starting the present season with a well attended meeting on Dec. 6th, which showed how great a need is filled by such an organization. The Association caters particularly to earnest and studious men who are ready to partake in impartial discussions on any

topics in the electrical engineering line. The present officers are as follows: President, Albert Scheible; Vice President, Wm. D. Ray; Secretary, H. G. Dimick; Treasurer, F. S. Hickok. An interesting discussion of the trolley or conduit outlook is expected at the next meeting.

THE McEWEN AUTOMATIC ENGINES.

The J. H. McEwen Mfg. Co. of 26 Cortlandt St., New York, whose high speed automatic engines have been on the market for the last four years, have recently made some improvements in the details of their engines, notably the governor and cross head which are illustrated in the accompanying engravings. Fig. 2 shows the new type of governor which is extremely simple, having but one bearing, and that, a roller pin bearing, which requires no lubrication, so that the want of lubrication will not affect its regulation; and as the spring is the only part that is adjustable, there can not be any trouble from misadjustment.

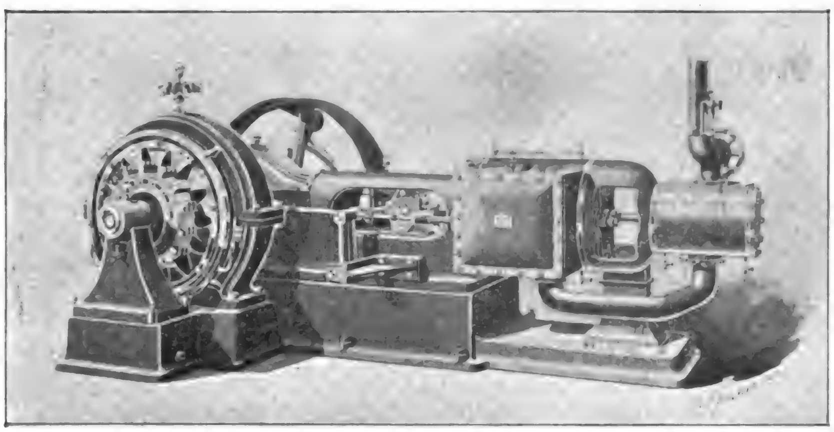


Fig. 1.—McEwen Automatic Engine Direct Connected to Thompson-Ryan Dynamo.

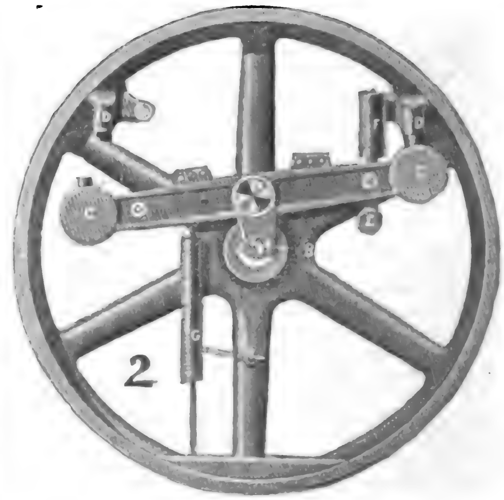
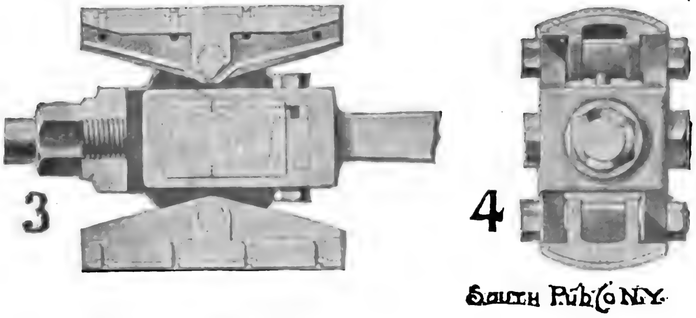


Fig. 2.

The regulation obtainable with this governor is so fine that the company guarantees that the engine shall not vary one revolution between full load and no load.

Figs. 3 and 4 show the construction of the cross head. The shoes are held in position by eccentric bolts. To adjust the position of shoes for wear, it is only necessary to loosen a nut and turn the eccentric bolt to such an extent as is necessary to give proper adjustment. This nut is then tightened and will remain in that position. It will be noticed that the shoes swivel on the eccentric bolts, so that it is impossible for the shoes to have anything but a full bearing. Both upper and lower guides, as well as cross-head pin, are oiled from stationary sight feed oil cup on top of frame. The oil is wiped off by the upper shoe, and is caught in an oil groove shown, extending across face of shoe, and led through oil holes at each end of grooves to inside of upper shoe; thence to a funnel-shaped oil hole in strap of cross-head box to cross-head pin; from there it drops to the lower shoe and then through holes in this shoe to the lower guide.



Figs. 3 and 4.—Cross Head McEwen Automatic Engine.

The shoes are faced with genuine babbitt which is put on in such a manner that it is as solid as though it was part of the shoe itself.

The McEwen engine is specially designed for direct connection to electric generators and the engraving Fig. 1 shows the same driving the Thompson-Ryan dynamo, the manufacture of which has been undertaken by the same company, who believe that the best results can be obtained when engine and dynamo are built by the same company.

NEW POWER HOUSE FOR MILFORD, MASS.

Local contractors are now figuring on the plans and specifications for the new power house to be erected by the Milford, Holliston & South Framingham Street Railway Company, the plans being in the office of selectman Jenkins. The structure is to be one-story, of brick, with granite underpinning, 80 feet long, 48 feet wide, exterior dimensions. The building is divided into an engine room 46.10 feet long by 41.8 wide, separated by an 8-inch brick wall from the boiler room, which is 31.2 feet long and 41.8 wide. The engine room is 12½ feet high to the foot of the roof trusses on top of side walls, and the boiler room is 20 feet high similarly. The excavation is to be not less than four feet and the foundations and cross walls 7½ feet high up to the brick work, to be of good split stone. The engine room floor is to be of cemented concrete, and the boiler room floor of hard burnt brick. The chimney is to be 75½ feet high above the underpinning, with walls 16 inches thick, the first 19½ feet, 12 inches thick up to 45 feet high and 8 inches thick the rest of the height. The core is to be 8 inches thick throughout. Foundations for three steam boilers, two engines and two generators are to be laid.

OBITUARY.

GEORGE B. WHITNEY.

The death is announced of Mr. G. B. Whitney, electrician of the Lowell, Mass., Fire Department. He had had charge of the fire alarm service since 1872. The cause of death was pneumonia.

LEGAL NOTES.

ASSESSING PATENT RIGHTS FOR TAXATION.

Judge Bartlett, of the Supreme Court, in Brooklyn, last week, heard argument on the application of the Edison Electric Light Company to review the assessment placed on its personal property by the Board of Assessors for 1895. Edward M. Shepard and Frank H. Field represented the company and Assistant Corporation Counsel Yonge appeared for the Board. The point to which especial attention was called by counsel was: "Had the Board power to assess for taxation any patent rights granted by the United States Government?" Judge Bartlett reserved decision.

EDUCATIONAL.

UNIVERSITY OF ILLINOIS.

The Board of Trustees of the University of Illinois have made two important promotions. Mr. William Esty has been raised from the position of instructor in electrical engineering to that of assistant professor, and Mr. Sager, who has been instructor in physics for the past year, has been made assistant professor in that department.

Mr. H. E. Dey's lecture on hydraulic gearing for street car motors, etc., before the Brooklyn Electrical Society, has been postponed until January 7, 1896.

Trade Notes and Novelties
AND MECHANICAL DEPARTMENT.

THE H. W. JOHNS EXHIBIT AT THE ATLANTA EXPOSITION.

One of the distinctive exhibits at the Atlanta Exposition is that of the H. W. Johns Manufacturing Co. comprising as it does insulating materials almost exclusively. The Company's trolley line insulating materials are very well known and also the Vulcabeston insulating material, which has numerous applications as a tough and heat proof insulation in the electrical industry. Sample boards display the recent and characteristic forms of trolley line apparatus insulated with moulded mica. Recent forms of straight under-running switches and the Philadelphia insulated crossings and breaks are also shown.

A conspicuous feature is the large number of Vulcabeston pieces illustrating the wide variety of size and shapes in which the material has been moulded to meet the requirements of manufacturers of electric devices. One of the largest uses of Vulcabeston is in street car controllers, owing to its toughness, durability and heat resisting qualities.

Monarch insulating material, which is black in color, and

THE H. W. JOHNS EXHIBIT AT ATLANTA.

moulded mica, in either brown or black, are shown in connection with some of the devices in which they have been used for insulation. Some of the devices thus insulated are Rowand's thermostat, made by the Universal Fire Alarm Co. of Camden, N. J., Heisler's lamp sockets and the Cutter, Gibbs and Stevens switches and devices of the Electric Protective Co. of Philadelphia.

The H. W. Johns Manufacturing Co. has also entered the electric heater field, as is evidenced by samples of various forms of car heaters displayed. These are novel in construction and consist of asbestos-insulated and protected resistance wires woven into the form of a heating pad. Some of these are already in use with very satisfactory results. For therapeutic uses, in making a local application of heat, the heating pads, or "electrotherms," as they are called, are made small and portable for the physician's use.

The exhibit is very tastefully arranged and the Company has been awarded a silver medal for its insulating materials and also a bronze medal for the electrotherms. In addition to these awards the company received in connection with its exhibit of asbestos and manufactured articles in the Mining Building, the gold medal or prize of honor for superior excellence, one silver and one bronze medal and an honorable mention.

MR. HARRY M. DOTY has succeeded Mr. T. Sprague as manager of the electric light plant at Chatham, N. Y.

MR. E. E. CARY has accepted the position of general manager of the Packard Electric Co. of St. Catharines, Ont., where the company has a large plant with fine water power and is making the Packard lamp and transformer, as well as handling a complete line of supplies.

THE MICANITE INSULATION USED IN THE FERRANTI ALTERNATOR AT DEPTFORD, ENGLAND.

In describing the gigantic Ferranti alternator at Deptford, the London *Electrical Engineer* remarks, in reference to the armature (which weighs 35 tons):

"The smaller end is of solid brass, burnt on to the strips; and to this, is connected the inner end of the bare copper conductor. The segment is then wound with the conductor, which has corrugation to prevent side displacement, and the adjacent turns are insulated. Two adjacent segments are clamped together in one carrier, and the outside ends of these conductors are connected where they touch; the two bolts clamping them into the carrier, then form the two connections to the segments. The insulation between the carrier and the coils is effected with micanite shields. The carriers consist of two heavy brass castings clamped on to the segments. The complete carrier is supported on two bolts projecting from the rim. The insulation of these bolts is a matter of great importance. The field coils on this de Ferranti alternator are constructed by winding bare copper strips on edge into a spiral, with insulation between adjacent turns. The danger of the high voltage from the bare copper of the armature sparking across to the field, has been overcome, in this case, by placing micanite caps over the poles. These caps, which are about ⅛ inch thick, have all been tested up to 25,000 volts. Since being in use, no faults have developed in them."

The micanite used in the construction of this machine was manufactured in the American factory of the Mica Insulator Company, at Schenectady, N. Y. This Company has recently established a factory in London, England, where they also manufacture micanite in its various forms.

A FEW RECENT EDDY MOTOR INSTALLATIONS.

The Eddy Electric Mfg. Co., of Windsor, Conn. report the following executed sales, all the apparatus being for immediate use: Stanley Works, New Britain, Conn., 45 K. W. generator, 7½ H. P. motor; Eldredge Bldg., Boylston St., Boston, two 40 K. W., M. P. lighting generators; Hartford Rubber Works Co., Hartford, 60 K. W., M. P. lighting generator; Hartford Cycle Co., 65 K. W., M. P. lighting generator; Fraser & Chalmers, Baker City, Ore., 60 K. W., M. P. generator, 75 H. P., M. P. motor; Central Coal & Coke Co., Texarkana, Ark., 30 K. W., M. P. lighting generator; Chambers Elec. Lt. & Power Co., Truro, Nova Scotia, 60 K. W., M. P. lighting generator; Lowell Elec. Lt. Corporation, Lowell, Mass., two 150 K. W., 500 volt M. P. power generators; New York *Herald*, four 60 K. W., M. P. lighting generators; Hammerstein's Olympia Theatre, New York, four 100 K. W., M. P. lighting generators; Burlington Woolen Co., Winooski, Vt., 40 K. W., M. P. lighting generator; Culver Military Academy, Marmont, Ind., 30 K. W., M. P. lighting generator; M. T. Davis & Co., Montgomery, W. Va., 65 K. W., M. P. power generator; Maine State College, Orono, Me., 30 K. W., M. P. lighting generator.

NEW YORK NOTES.

THE ERWIN MFG. CO. has been formed at Greenbush, N. Y., with a capital stock of $5,000 to deal in electrical and mechanical specialties. The directors are John Erwin, and W. W. Grey of Albany; and R. J. Pratt of Greenbush Heights.

THE BERLIN IRON BRIDGE CO., of East Berlin, Conn., have just completed for the Standard Oil Co., at Constable Hook, N. J., a compounding building 120 ft. wide by 130 ft. long. The roof trusses are composed of steel, with steel purlins and covered with galvanized corrugated iron.

THE MICA INSULATOR CO. have purchased the entire business of the Empire Electric Insulation Co., of Schenectady, N. Y., manufacturers of oil insulating cloth and paper. They will continue the business in connection with the manufacture of their well known Micanite specialties.

MESSRS. J. JONES & SON, 67 Cortlandt street, are extending their manufactures in their Brooklyn factory to include a complete line of electric light fittings, the workmanship of which will, of course, be first-class, while the designs will be thoroughly up to date in their conception. Among the specialties turned out by this firm will be cut-outs, attachment plugs, fixtures and electric portables.

T. J. MURPHY, No. 126 Liberty St., has some pretty work on exhibition in his office in the way of marbleized slate for electrical work, and in switchboard mountings carries a complete line of fancy fastening bolts, pillar mountings, etc. One of his recent devices is his slate lined box, including a slab of slate in the door, making a perfectly fire proof enclosure, while another is a scheme for fastening various slabs together in such a way that should one section for any reason have to be removed, it may be done without disturbing in any way any other section of slate.

THE DICKINSON ADVERTISING SIGNS.

A decided novelty in the way of advertising signs is that offered by the Dickinson Electric Supply Company, Tract Building, New York. A number of schemes for electric display are now on the market in more or less familiar form, and the eye is dazzled at the brilliant lighting effects in letters and colors which shine from the shops; but the Dickinson device known as the "Alpha" presents so simple a method of display, together with effectiveness, and combining also a moderate first cost with economy of maintenance, that it would seem as though the device should find a ready sale, and that presently it will be the Alpha advertising sign that attracts the footsteps of the shoppers.

The illustration presents a good view of the lamps. In

THE DICKINSON ADVERTISING SIGN.

making, they are blown with a flattened-end bulb instead of conforming entirely to the pear shape. At this flat end a coating of japan is applied which forms a black ground to the letter, the lamp being frosted so that only a diffusion and not a glare of light is present, and of course the only thing that confronts the eye is the letter of the alphabet thus boldly proclaiming itself.

The utility of this plan is at once apparent. Instead of using several incandescent lamps to form a single letter of the alphabet, each lamp is a letter in itself, and in buying these lamps any letters or combination of letters may be purchased, so that each customer is his own sign maker. A good display for example could be made in a tobacconist's window, announcing a certain brand of cigars; while the groceries will doubtless fall into line with a display of illuminated cereals, etc.

It will be observed that these letters are of course interchangeable so that there is no limit to their usefulness. The Alpha is surely a long step in advance of the electric light advertising now in vogue, and it will be a pleasure to see the genius of the inventor rewarded by its universal adoption.

The names of the officers of the Company are: H. H. Dickinson, Pres.; A. S. Goodacre, Treas.; A. L. McGilliwie, General Manager.

THE PECK ELECTRICAL CO.

MR. E. F. PECK, Vice President of the National Electric Light Association, who for the last ten years has been the General Superintendent of the Citizen's Electric Illuminating Company, of Brooklyn, has formed a company to be known as the Peck Electrical Company, with offices at 15 Cortlandt St., New York. The company proposes to manufacture and deal in electrical specialties and supplies and also to engage in electrical engineering in all its branches. Mr. Peck's long and practical experience as Superintendent of one of the largest and most successful electric lighting plants in the country together with his recognized capacity as an electrical engineer will undoubtedly command for the company a large share of public and private patronage.

CHAPIN-DOUGLAS ELECTRIC CO.

The above concern has been formed by Chas. E. Chapin and J. S. Douglas, the former being president and the latter secretary and treasurer. They will act as manufacturers' agents in the handling of general electrical supplies, and have already several desirable specialties on their list. The offices are at 136 Liberty street, New York.

NEW YORK NOTES.

STANLEY & PATTERSON, of New York, have been appointed sole agents in New York for the well-known Packard incandescent lamp, manufactured by the New York & Ohio Co., of Warren, O., and will carry at all times a full line in stock in this city.

F. S. DERONDE, of New York, has just issued a neat price list of the celebrated "Ship" cored and solid carbons, manufactured, as is well known, by Schiff, Jordan & Co., in Vienna, Austria. These carbons are specially made for use where a very steady and brilliant light is wanted and all users of arc lights should give them a trial.

"*Electricity.*"—The address of this English electrical journal is now 11 Ludgate Hill, London, E. C.

NEW ENGLAND NOTES.

THE VERMONT STATE ASYLUM at Waterbury, has put in an electric light plant. A Ball engine, built by the Ball Engine Co., Erie, Pa., furnishes power.

MERIDEN, CONN.—The Meriden Street Railway Co. has sold its system to the New York, New Haven & Hartford Railroad Co. for the sum of $750,000.

THE GRAHAM EQUIPMENT CO., of Boston, has been sending out some effective large postal cards illustrating and describing special features of its steel trucks now being generally introduced in street car practice. One of the cards shows a car at Butte, Mont., loaded with bicyclists, and with their bicycles hanging on hooks.

THE BERLIN IRON BRIDGE CO., of East Berlin, Conn., have just completed for the United States Projectile Co., at South Brooklyn, N. Y., the steel framework for a new annealing room. The building is 100' wide and 150' long, and is designed to be a fire-proof structure.

THE BERLIN IRON BRIDGE CO., of East Berlin, Conn., have just completed for the Somerville Woolen Mills, at Somerville, N. J., a spinning room, 54 ft. wide and 210 feet long, and a boiler room 40 ft. wide and 216 ft. long. The construction of the spinning room is steel trusses, with heavy plank floors and roof. The boiler room is constructed with brick walls, steel trusses and corrugated steel covering, making it absolutely fire-proof.

WESTERN NOTES.

MR. JAMES I. AYER, of St. Louis, Mo., made a short stay in Chicago a few days ago on his return from an Eastern trip.

MONROVIA, CAL., will shortly have an electric plant put in for light, heat and power purposes.

SAN FRANCISCO, CAL.—It is stated that the 'Frisco Gas Light Company will put in a large electric lighting plant, and that Siemens-Halske apparatus will be used.

TOPEKA, KAN.—The Western Electric, Standard, Westinghouse, Fort Wayne, and other companies, have been bidding on new arc lighting apparatus for the Topeka municipal plant.

MR. E. W. LITTLE, Vice-President and General Manager of the Interior Conduit and Insulation Co. has been visiting Chicago for some days past and left for home last week.

THE CHICAGO EDISON CO. reports a net income for the first seven months of the present fiscal year 21 per cent. greater than in the like period of 1894.

THE ELECTRIC APPLIANCE COMPANY state that they are rapidly securing their share of the interior conduit business, and that with a large stock and a high grade article at a low price they are making themselves felt in the conduit field which is becoming such a very essential part of the electrical supply business.

THE WASHINGTON ELECTRIC CO., 207 So. Canal street, Chicago, find that their present quarters are too small to allow them to get out their orders as rapidly as they would wish; and as there is every prospect of their present volume of business increasing, they are contemplating the desirability of moving into larger premises shortly so as to be able to execute their orders more expeditiously.

THE OHIO STORAGE BATTERY CO. of 52 Wade Building, Cleveland, are pushing their storage battery business very actively on the lines indicated in their advertisement in the ENGINEER of Dec. 11. Having satisfied themselves as to their freedom from infringement, they are ready to fill contracts for all classes of work and with large or small equipments, ranging from street railways to medical apparatus.

EAST ST. LOUIS MESSENGER SERVICE.—The Southwestern Telegraph Company, represented by Anthony Isch, Cashier of the Workingmen's Bank, East St. Louis, has been granted an exclusive franchise by the City Council, to build, maintain and operate for 20 years, a district messenger and signal service. It agreed to provide the city with 20 free boxes, in different parts of the city.

THE UPTON ARC LAMP for alternating current (made noiseless by means of the new anti-hum device which is applied exclusively to the Upton Lamp) is one of the most popular specialties in the long repertory of the Electric Appliance Company, who state that every sample sent out means an additional regular customer for the Upton Lamp. The cost of this anti-hum device is comparatively small; and, it is said, makes the difference between a satisfactory and an unsatisfactory alternating arc lamp for inside use.

Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

42 Sheet 1. TABLE FOR CALCULATING TURNS AND RESISTANCE OF MAGNET SPOOLS. B.

Let V = winding volume in cubic inches of any spool; let N = ohms in a cubic inch for the size of wire selected for winding; let R = the known required resistance. When V and N are known, then $R = V \times N$; when V and R are known, then $N = R \div V$; when R and N are known, then $V = R \div N$.

In a case where the number of turns, the area of the space through which all turns pass, and the total number of turns, on a given spool are involved, use the following formulæ:

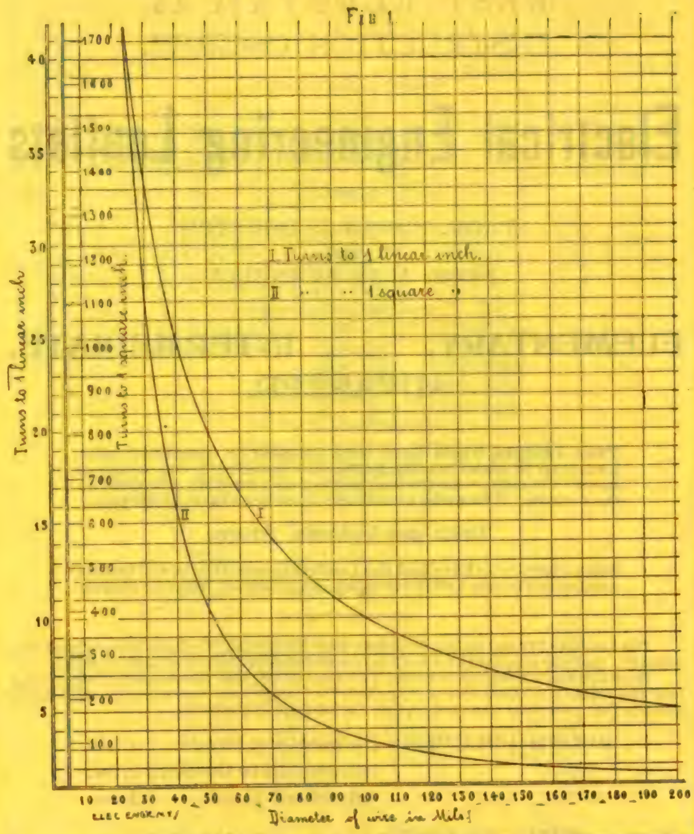
Let A = area of winding space through which all turns pass; let T = the number of turns per sq. in. of the size wire selected; let S = the total number of turns required. When A and T are known, $S = A \times T$; when A and S are known, $T = S \div A$; when S and T are known, $A = S \div T$.

Fig. 1, **42**, Sheet 2, shows the relation that exists between diameter of any wire turns per linear inch and turns per square inch. This can be used where the diameter of wire over any covering is known to determine turns per square inch, and if its resistance is known, the resistance per cubic inch can be easily calculated.

Size B. & S. Base Capped.	Max. Diam. of D. C. C. Wire.	Turns per inch.	T Turns per square inch.	N Resistance per cubic inch internat. (ohms) 20° C.
5	.197	5.0761	25.7668	.0006725
6	.177	5.6497	31.9191	.0010502
7	.159	6.2893	39.5555	.0016377
8	.143	6.9930	48.9020	.0025575
9	.129	7.7519	60.2305	.0039601
10	.117	8.5470	78.0512	.0060705
11	.106	9.4339	88.9985	.0093448
12	.093	10.7527	115.6205	.0152619
13	.084	12.0482	145.1591	.0240964
14	.075	13.3333	177.7777	.0373333
15	.067	14.9254	222.7674	.0590334
16	.061	16.3934	268.7435	.0895991
17	.055	18.1818	330.5782	.139173
18	.050	20.0000	400.0000	.212400
19	.046	21.7396	473.4760	.317229
20	.042	23.8095	566.8924	.479024
21	.038	26.3158	692.5214	.737535
22	.035	28.5714	876.3250	1.096324
23	.033	30.3030	918.2718	1.554637
24	.030	33.3333	1111.1111	2.373333
25	.028	35.7270	1276.4100	3.436108
26	.026	38.4615	1479.2870	5.022182

The above table is the Maximum Diameter D. C. C. made by three manufacturers.

42 Sheet 2. TABLE FOR CALCULATING TURNS AND RESISTANCE OF MAGNET SPOOLS. B.



CURVES SHOWING RELATION BETWEEN DIAMETER OF WIRE TURNS PER LINEAR INCH AND PER SQUARE INCH.

5932 Sheet 1. THE TELEPHONE RECEIVER. B.

As the telephone receiver is being used to a great extent in testing for leaks, grounds, faults in electrical apparatus, inductive effects, etc., a drawing and specification of same is, at times, useful. W. H. Preece states in his Manual of Telephony, page 26, that the Bell receiver is sensitive to a current 6×10^{-13} ampere or, six ten thousand millionths of a milliampere.

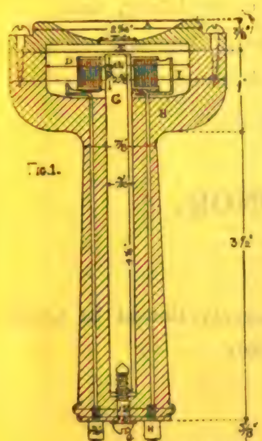


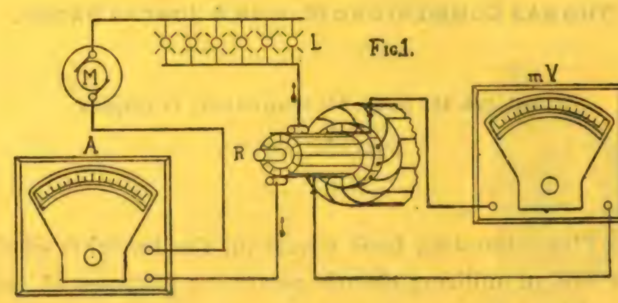
Fig. 1.

Fig. 1 snows a section through a convenient form of receiver. The case B, and mouth-piece A, can be turned out of well seasoned hard wood, walnut or maple preferred. The diaphragm E is a disc, two inches in diameter, cut from ferrotype iron from 6 to 10 mils thick. The magnet C is made of steel rod $\frac{5}{16}$ diameter, and after the hole is drilled and tapped for the adjusting screw G, it should be tempered hard and magnetized. The bobbin D to hold the wire can be turned out of hard rubber or box wood and should slip tightly over the end of the bar magnet. It is wound with No. 36 B. & S. single silk covered wire and has a resistance of about 100 ohms. The leads from the winding on the bobbin should be a number of strands of No. 36 wire, in order to prevent these connections being broken in handling. The stranded wire is again soldered to two stout copper wires I which pass through two holes that have been bored through the handle of the receiver, and are then connected to the binding posts H, provided on the end of the receiver. To get the best results the diaphragm should not be pinched too tightly between the mouth-piece and the case of the receiver when this is screwed down.

508 Sheet 2. DROP METHOD OF MEASURING RESISTANCES. B.

The drop method of measuring resistances consists of accurately determining the fall of potential due to a known current flowing through the conductor to be measured. Fig. 1 is a diagram of connections for this test: N is a source of electromotive force; A, standard ampere meter; MV, millivoltmeter; L is a lamp bank, or any suitable adjustable current consuming device; R is the resistance to be measured, which is a bipolar armature in this case. This method is specially applicable to low resistance measurements such as conductivity test and armature resistances.

There are points which should be observed in its use in order to obtain reliable results. The millivoltmeter terminals should take the drop from the conductor to be measured, directly, and not by means of the terminals which carry the current into the conductor, for in this case the drop of volts would be increased over the true drop on the conductor due to the resistance of contact between the terminal and the conductor to be measured.



Where the length of the conductor is also to be considered, the drop points should be taken at points of the conductor through which all the current passes and the length measured will be the distance between these drop points.

The leads to the millivoltmeter, should be short and of low resistance; also the contact to the resistance to be measured should be good, in order that the resistance may be so small as to be neglected. The current used for measuring should be as constant as possible. If a current of one ampere is used, one millivolt will represent 0.001 of an ohm resistance and if a current of 10 amperes is used one millivolt will represent 0.0001 of an ohm.

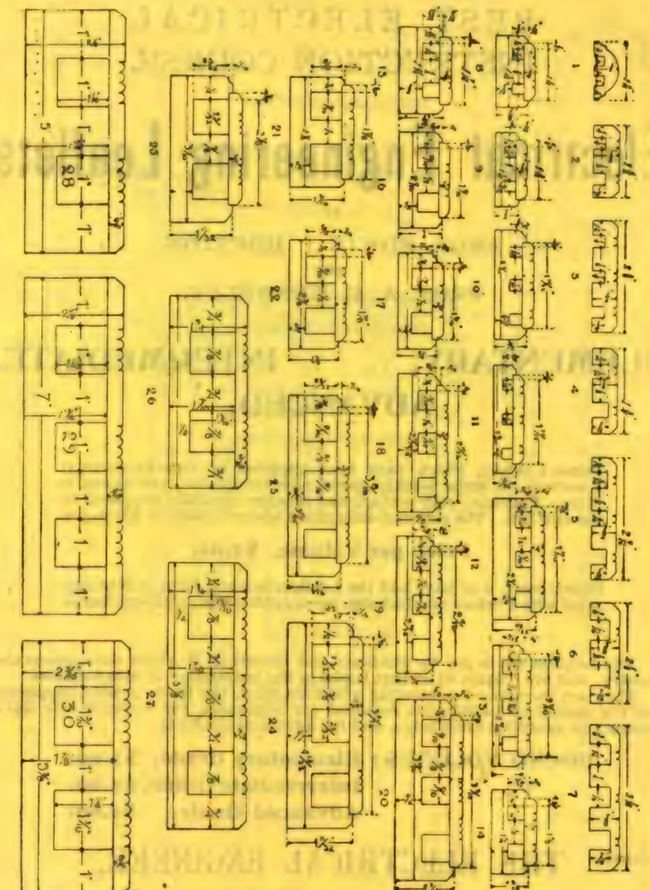
5725 Sheet 3. | **WIRING IN MOULDINGS.** | **B.**

Where semi-exposed wiring can be used, the general practice is to enclose the wires in a wooden moulding. The National Electric Light Association's rules touching on this method of wiring is found in those clauses regarding conductors, as follows :—

1. Must not be of sizes smaller than No. 16 B. & S., No. 18 B. W. G. or No. 8 E. S. G.
2. Must not be paraffine covered.
3. Must not be covered with soft rubber tube.
4. Must not be laid in mouldings of any kind in damp places.
5. Must not be laid in mouldings with open grooves against the wall or ceiling.
6. Must not be laid in mouldings where less than half an inch of solid insulation is between parallel wire and between wires and walls or ceilings.
7. Must not be laid in plaster, cement or similar finish, without an exterior metallic protection.
8. Mouldings, where admissable, must have at least two coats of waterproof paint, or be impregnated with a moisture repellent.

Sheet 4, 5725 gives the size of standard incandescent wiring mouldings, which are usually kept in stock in pine or white wood, but this moulding can be made up in different woods or with different finishes to suit the trim of the interiors where they are to be used. From No. 1 to 7 inclusive, are mouldings for two and three-wire systems which have no backings, and are as a rule not allowed by underwriters without a backing of at least one-half inch. From No. 8 to 30 inclusive are standard sizes of grooved mouldings with capping which are kept in stock in about twelve foot lengths; the different sizes of wire that they will hold can be found from the table at the foot of **5725**, Sheet 2. The appearance of moulding work greatly depends on the care that is used in mitering and joining.

5725 Sheet 4. | **SIZES OF STANDARD MOULDINGS.** | **B.**



8533 Sheet 1. | **BELTING.—GENERAL FORMULÆ AND PRACTICE.** | **B.**

To determine the length of belts, the most direct method is to measure, with a steel tape, the actual length of belt over both pulleys with the minimum distance between them; but where an actual measurement cannot be made, the following approximate formulæ will be useful :—

Add diameters of both pulleys together, and divide the sum by two, and multiply the quotient by $\pi = 3.1416$; add to this product, twice the distance between the centres of the shafts.

The above rule is correct, when both pulleys are the same size, but departs from accuracy as their diameters differ from each other. Where the dynamo is on sliding rails, the dynamo should be as near the driving pulley as the rails will allow, and then take the measurement for the belt when in this position.

The weakest part of a laced belt is where the holes are punched for lacing; the different parts of the belt bear the following relation regarding breaking strength : Per square inch of section, at lacings, 958 lbs.; at splicing, 1,744 lbs.; at solid part, 3,086 lbs. In lacing, begin in the centre of the belt and take care to keep the ends exactly in line and to lace both sides with equal tightness. The lacing should not be crossed on the pulley side of the belt. To run the flesh side of the belt outside will give the longest wear.

The distance between the driving and dynamo pulleys should be such, that the arc of contact on the dynamo pulley will be sufficient for the power to be transmitted without excessive belt tension. Below is given a table of practical determinations, made on Edison bi-polar dynamos, as to the limiting distance between the centre of dynamo shaft and driver shaft with all dimensions fixed; belt speeds about 4,500 feet per minute; this is the average belt speed for these dynamos.

H. P. transmitted.	Width of pulley in inches.	Diam. dynamo pulley in inches.	Rev. per minute.	Driver pulley diameter in inches.	Rev. per minute.	Minimum distance between centres of shafts in feet.
20	8"	11¼"	1500	52"	325	12½′
26	9"	12"	1400	60"	282	13′
33	10"	13"	1300	60"	282	14′
40	11"	14"	1200	60"	282	14′
60	12"	17"	1000	66"	260	15′
80	13"	24"	700	66"	260	15′
134	16"	26"	650	86"	200	16′

5757 Sheet 1. | **GROUND CONNECTIONS FOR LIGHTNING ARRESTERS.** | **B.**

To derive the benefits of a good lightning arrester, a good connection from the arrester to ground, is necessary. The high oscillatory character of the lightning discharge, as far as we know, has to be treated in the same way as a current possessing a very high frequency, and the ground connection becomes a very important factor in station protection.

Every obstruction to the flow of this discharge, offered by the ground wire, subjects the station apparatus to a stress tending to break it down at its weakest point. When the charge arrives at the station, it has two paths, one through the air-gap of the arrester, and then to ground, and the other through the apparatus in the station, through its weakest point of insulation to the ground; every means should be used so the lightning can jump the spark gap of the arrester and pass to ground, and this will decrease the electro-static stress, and consequently the hazard of the appliances in the station to the destructive effects of the discharge.

With high frequency, the current has a tendency to travel on the surface, rather than on the interior of the wire, and choke its own passage in this way, and this effect increases, as the diameter of the wire increases, and consequently only small wire should be used for a ground conductor; No. 6 B. & S. being the usual size.

A bend in the conductor greatly increases its self-induction; consequently, the wire should be as straight as possible from the point of connection at the lightning arresters to the ground connections. Carrying this wire parallel or near masses of iron, will also tend to retard by self-induction the passage of the discharge to earth.

To use a water-pipe system for the earthing devices, is not the best practice, but where it is necessary, the best method of connecting, is to solder the conductor into a brass lug, and then bolt this securely to the pipe, after the contact surfaces of the pipe and lug have been thoroughly cleaned. The connection after being made, should be painted over with two coats of air drying asphalt varnish. No ground connections that are used for any other purpose, should be used for the lightning arrester ground. No part of an iron structure or piping through the building, should be used for the purpose of this conductor. The ground conductor should be connected to the water system, as near its entrance to the earth as possible.

A ground, near running water or naturally moist earth, will give the best results, but in all cases it must be below the frost line. If these cannot be secured, a hole can be sunk in the ground until water is reached. A copper plate 2x2 feet, with the conductor firmly soldered to it, will in ordinary cases be adequate for lightning ground. Loose waste metal does not materially increase the actual contact area of the earth plate; if such material is used for the earth plate, each piece should be connected securely with the ground conductor. The best material to use to get a low resistance ground, is broken coke. This should be first tamped well in the bottom of the hole, to the depth of about 2′, then the copper plate laid on this, and then about 4′ more laid over the plate and tamped well. Dirt can then be thrown on this, and tamped lightly.